

**ESTIMATES OF ASSOCIATION BETWEEN COGNITIVE COMPLEXITY LEVELS
AND CREATIVITY LEVELS OF FIELD GRADE MILITARY OFFICERS: AN
EXPLORATORY STUDY OF THE RELATIONSHIP**

by

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E.M.B.A., Benedictine College 2002
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AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

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Abstract

The purpose of this study was to investigate the association between cognitive complexity and creativity. This research was conducted with a sample ($n = 126$) of field grade officers at the Joint and Combined Warfighter School in Norfolk, VA, as part of class 08-02 ($N = 250$), in early 2008. The Department of Defense (DoD) challenges its officers to operate in ambiguity, solve complex problems and be creative. The DoD states that it needs its officers to apply a creative imagination, supported by skill, knowledge, and experience, to design integrated operational plans that employ military forces. In order to do this, the DoD teaches its officers cognitive thinking skills and creativity at the same time. Are cognitive thinking skills and creativity correlated? Two valid and reliable tests were used to test for cognitive complexity and creativity: the Learning Environments Preference (LEP) and the Torrance Tests of Creative Thinking (TTCT), both the Figural-A and the Verbal-A forms. A small positive but statistically insignificant ($\tau = .083$) correlation was found between the measured levels of cognitive development (LEP CCI) and the measured level of creativity (TTCT). In addition, this research analyzed the effect that branch of service, combat experience, gender, age, and education level had on creativity and cognitive complexity. There was a strong positive correlation between cognitive complexity and level of civilian education level ($\tau = .345, p < .001$). There was a strong positive correlation between creativity and level of civilian education level ($\tau = .341, p < .001$). When LEP CCI scores (cognition) were correlated to TTCT creativity scores while controlling for combat experience there was a medium positive correlation ($r = .285, p = .007$). When combat experience was correlated to the LEP CCI scores (cognition) there was a medium positive correlation ($\tau = .246, p = .002$). There was a medium positive correlation between military rank and LEP CCI (cognition) scores ($\tau = .228, p = .002$). There was a small positive correlation between military rank and TTCT creativity scores ($\tau = .15, p = .042$). When gender was correlated to the TTCT scores (creativity), there was a statistically significant positive correlation for females ($\tau = .151, p = .041$). A small positive but statistically insignificant ($r = .111$) correlation was present between the level of creativity, the level of cognitive development, and age. There was a small positive but statistically insignificant ($r = .109$) correlation between the level of creativity, the level of cognitive development, and branch of service.

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Table of Contents

List of Figures	xiii
List of Tables	xiv
CHAPTER 1 - Introduction.....	1
Overview	1
Background.....	1
Theoretical Rationale	4
Creativity	4
Mystical Approaches	6
Pragmatic Approaches	6
Psychoanalytic Approaches	7
Social-personality Approach.....	7
Psychometric Approaches.....	7
Convergence of Approaches	8
Higher Order Thinking, Complex Thinking and Cognitive Psychology.....	8
William Perry	10
William S. Moore’s Expansion of Perry’s Theory of Cognitive Development.....	11
Theoretical Approaches Followed in This Study.....	13
Problem Statement	14
Purpose Statement.....	14
Research Questions	15
Design of the Study.....	16
Procedure.....	16
The Instruments.....	16
Learning Environments Preference (LEP).....	16
Torrance Tests of Creative Thinking (TTCT).....	17
The Population	19
The Sample	19
Recording and Scoring of Data.....	19
Data Analysis	20

Significance of the Study.....	20
Limitations of the Study	21
Definition of Terms.....	21
Summary.....	23
CHAPTER 2 - Literature Review	24
Introduction.....	24
How Does This Research Contribute to the Field?	26
Creativity	27
Origins	27
A History of Creativity	27
Twentieth and Twenty-first Century Research	34
What is the Field?.....	39
What Are the Approaches?	39
Recent Research on Creativity and Their Approach	39
Pragmatic	39
Psychoanalytic.....	41
Psychometric	41
Social-Personality.....	44
Neuro-Scientific	45
Cognitive Complexity	45
Cognitive Psychology.....	45
Jean Piaget.....	46
Robert Kegan	46
Lev Vygotsky	47
Marcia Baxter Magolda	47
Patricia King and Karen Kitchener.....	48
Mary Field Belenky, Blythe McVicker Clinchy, Nancy Rule Goldberger, and Jill Mattuck Tarule	48
How They Relate to Each Other	49
William Perry	50
William S. Moore’s Expansion of Perry’s Theory of Cognitive Development.....	51

The Military, Creativity and Cognition.....	53
A Connection between Cognition and a Psychometric Approach to Creativity	63
Psychometric Approach and Torrance	63
Cognitive Psychology and the Connection to Creativity.....	65
Testing for Creativity: Two Camps.....	67
Neuroscience: The Bridge between Cognitive Psychology and Creativity?.....	68
Summary.....	70
CHAPTER 3 - Methodology	71
Introduction.....	71
Research Questions	72
Design of the Study.....	72
Correlational Studies	73
Part and Partial Correlations	74
Partial Correlations	74
Part (Semi-Partial) Correlations	75
Procedure.....	76
The Instruments.....	77
Learning Environments Preference (LEP).....	77
Torrance Tests of Creative Thinking (TTCT).....	80
The Population	85
The Sample	86
Recording and Scoring of Data.....	86
Data Analysis.....	87
Protection of Human Rights	88
Summary.....	88
CHAPTER 4 - Findings	90
Overview	90
Demographics	90
The Sample	90
Age.....	90
Gender.....	91

Military Service	91
Military Rank	91
Combat Experience	91
Education	91
LEP Results	92
Torrance Tests of Creative Thinking Results	94
TTCT-Figural	95
TTCT-Verbal	96
TTCT Composite Scores for Each Subject	97
Correlation between Creativity and Cognition	98
Additional Correlations	100
Partial Correlations between Creativity, Cognition and Other Variables	100
Creativity, Cognition Controlling for Branch of Service	100
Creativity, Cognition Controlling for Combat Experience	101
Creativity, Cognition Controlling for Gender	101
Creativity, Cognition Controlling for Education Level	102
Creativity, Cognition Controlling for Age	103
Creativity, Cognition Controlling for Military Rank	104
Bivariate Correlations Relevant to Creativity and Cognition	104
Creativity, Cognition and Branch of Service	104
Creativity, Cognition and Combat Experience	105
Creativity, Cognition and Gender	106
Creativity, Cognition and Education Level	107
Creativity, Cognition and Age	107
Creativity, Cognition and Military Rank	108
Other Correlations not Involving Creativity or Cognition	109
Age, Combat Experience and Education Level	109
Branch of Service and Length of Combat Tour	110
Branch of Service and Civilian Education Level	110
Summary of Research Findings	111
CHAPTER 5 - Summary and Discussion	114

Overview	114
Limitations of the Study	114
Restatement of Problem	114
Review of Research Methods	115
Discussion of Findings and Conclusions.....	117
Research Question 1	117
Research Question 2	118
Research Question 3	119
Research Question 4	121
Research Question 5	123
Research Question 6	124
Additional Correlations	125
Implications of Results.....	128
Practice Implications	128
Create Attitudes Conducive to Creativity.....	129
Creativity versus Competence.....	129
Creativity in Education	130
Predicting Future Threats.....	131
Recommendations for Future Research	132
Summary.....	134
References	135
Appendix A - LEP CCI and TTCT Scores for Subjects	148
Appendix B - Demographic Data of Subjects	152
Appendix C - Permission to Use Learning Environments Preference Instrument	160
Appendix D - Informed Consent Form	161
Appendix E - Student Information Form	163
Appendix F - Kendall's Tau Correlations	164
Appendix G - Military Commissioned Officer Ranks	165

List of Figures

Figure 1.1 Approaches to Creativity	6
Figure 1.2 Higher Order Thinking: Complex Thinking and Cognitive Psychology	9
Figure 1.3 Correlation between Cognitive Development and Level of Creativity	15
Figure 2.1 Area of Research	24
Figure 2.2 Taxonomy of Literature Review	26
Figure 2.3 The Convergence of Cognitive Development, Creativity and Neuroscience	69
Figure 3.1 Correlations	74
Figure 3.2 The Principle of Partial Correlation	75
Figure 3.3 The Difference between Partial and Part (Semi-Partial) Correlations	76
Figure 4.1 Sample Demographics	92

List of Tables

Table 4.1 LEP CCI, the Perry Positions and Number of Subjects in Each Category	93
Table 4.2 LEP Descriptive Statistics.....	94
Table 4.3 TTCT-Figural Descriptive Statistics	95
Table 4.4 TTCT-Verbal Descriptive Statistics	96
Table 4.5 TTCT-Figural and Verbal Correlation.....	97
Table 4.6 TTCT-Composite Scores Descriptive Statistics.....	98
Table 4.7 Correlation between Creativity and Cognition.....	99
Table 4.8 Partial Correlation between Creativity and Cognition, Controlling for Branch of Service	101
Table 4.9 Partial Correlation between Creativity and Cognition, Controlling for Combat	101
Table 4.10 Partial Correlation between Creativity and Cognition, Controlling for Gender	102
Table 4.11 Partial Correlation between Creativity, Cognition, Controlling for Level of Civilian Education	103
Table 4.12 Partial Correlation between Creativity, Cognition, Controlling for Age.....	103
Table 4.13 Partial Correlation between Creativity, Cognition, Controlling for Military Rank .	104
Table 4.14 Bivariate Correlations between Creativity and Cognition, and Branch of Service...	105
Table 4.15 Bivariate Correlations between Creativity and Cognition, and Combat	106
Table 4.16 Bivariate Correlations between Creativity and Cognition, and Gender	106
Table 4.17 Bivariate Correlations between Creativity, Cognition, and Level of Education.....	107
Table 4.18 Bivariate Correlations between Creativity, Cognition, and Age.....	108
Table 4.19 Bivariate Correlations between Creativity, Cognition, and Military Rank	108
Table 4.20 Bivariate Correlation between Age and Combat Experience	109
Table 4.21 Bivariate Correlation between Branch of Service and Length of Combat Tour.....	110
Table 4.22 Bivariate Correlation between Branch of Service and Civilian Education Level....	111

CHAPTER 1 - Introduction

Overview

This research investigates the relationship between cognitive complexity levels and creativity levels in field grade officers (see Appendix I for military rank structure) attending the Joint and Combined Warfighter School, at Norfolk, VA. This chapter provides an overview of the study. The next several paragraphs outline the reasons why this study is important and discusses some background. Next, a cursory overview of the relevant research is reviewed, supporting the study of cognitive complexity and creativity discussed in more detail in Chapter 2. This discussion highlights the importance of cognitive complexity and creativity, and how they might be related. Moreover, this section of the chapter discusses current research approaches to cognitive complexity and creativity, and selects approaches for comparison. The last part of this chapter issues the problem and purpose statements, gives research questions, illustrates the research methodology, reviews the population, introduces the instrumentation, presents the significance of the study, and summarizes the chapter.

Background

On 21 April 2008, Defense Secretary Robert M. Gates asked military officers to “become forward thinkers with courage to advance new approaches needed to confront current and emerging threats” (Miles, 2008, p.A3). In his speech to officers attending the Army’s Command and General Staff College and the Air Force’s Air War College, Gates challenged this group to “think outside the box to help the military to adapt to a constantly changing strategic environment...however, virtually every institution is organized in a way to stifle this kind of thinking” (Miles, 2008, p.A3). The Secretary of Defense stated that creativity and cognitive complexity are important qualities for officers to have.

The U.S. military forces in Iraq, Afghanistan, the Philippines, and other places in the world face new realities as they operate in an unconventional and irregular environment (Clark, 2006). The complex situations the forces confront require that they adapt with little or no advance notice. They must perform multiple roles: one minute they are peacekeepers and the next, they are warriors. They often find themselves in novel situations, but lack training on how

to meet the demands. Their orders are vague, and they are called to operate in ambiguous environments, yet the decisions they make can have severe potential consequences as well as strategic implications (Grossman, 2004). The conflict in Iraq taught many lessons, some the Department of Defense has learned. The situations our military faces today are unlike the problems it faced in the recent past (1980s and 90s) (Cohen, 2000). Ten years ago, if you asked military officers what kind of environment they had to prepare for, the answer would have been for high intensity conflict, mid-intensity conflict, or low intensity conflict. Special Operations Forces focused on mid- and low intensity conflict, while the other 98% of the Department of Defense focused on high intensity conflict. Ten years ago the task of *field armies* (euphemism for the combination of Army, Navy and Air Forces that fight together on land) was relatively easy in comparison to today; defeat the fielded army that opposes you. Identifying that force was also relatively easy when compared to today's standards; it was destroying that force that was the hard part. If 10% of the effort was put into finding the opposing force and 90% of the effort was put into destroying it, the paradigm is exactly the opposite now (*Field Manual 3.0*, 2007). The enemy that faces the military in 2007 is ambiguous and asymmetric. They fight us in non-linear and non-contiguous ways. The days are gone of lining up our force on one side of a border to destroy the force on the other side of the border. Because of this shift in the nature of warfare, the military faces many new challenges. Because of these challenges, soldiers have been operating in unconventional environments and dealing with ambiguity. The Department of Defense has been asking questions: How do we train soldiers to function in ambiguous environments? How can we equip them to perform in the face of uncertainty? How can we prepare them to operate in situations for which they lack training? The Army says that it needs soldiers that have the ability to think at a complex level (*Command and General Staff College campaign plan*, 2005). The military uses terms like self-awareness, creativity, and complex thinking to describe the qualities it desires in its officers (*Field Manual 3.0*, 2007).

Based on guidance from the *National Security Strategy* (2006), the *National Military Strategy* (2004), the *National Defense Strategy* (2005), and the *Quadrennial Defense Review* (U.S. Dept. of Defense, 2006), the Commandant of the Joint Forces Staff College (2007) decided that training and educating joint service military leaders on how to think is of paramount importance. The goal of the Joint Forces Staff College (JFSC) is to train and educate field grade officers in the art and science of war and to graduate officers that are creative with increased

complexity in their thinking (Joint Forces Staff College, 2007). At intermediate level education institutions, classes on creativity and complex thinking are taught together as one block. While there is no debate that both creativity and cognitive complexity are important, are creativity and cognitive complexity correlated?

In December 2001, Army Special Operations field commanders in Afghanistan questioned whether Army Special Forces officers were being selected and prepared effectively for combat operations (White et al., 2005). The reason for this reflection was the high rate of officers being relieved of duties in the opening months of Operation Enduring Freedom. This caused the Commandant of the United States Army John F. Kennedy Special Warfare Center and School (USAJFKSWCS) to conduct an evaluation of the assessment, selection, and training of Special Forces officers. The conclusion of this study recommended changes to the selection and training of its officers (White et al., 2005). Within the suggestions of the report was the inclusion of training on complex thinking scenarios, and the selection of officers based on their level of creativity. The full name of the program that was adopted by USAJFKSWCS was the Adaptive Thinking and Leadership (ATL) model.

If the military intends to train and educate its officers to be more creative and think in a more complex manner, it must examine whether its training and education methodology is sound. The first step in the process is to see if there is a correlation between creativity and cognitive complexity. Then an experimental methodology should be used to determine whether or not the classes on creativity and cognitive complexity actually make improvements in these levels (Campbell, 1979).

Recent studies indicated several correlations between cognition, genetics, intelligence, and creativity. Grigorenko (2007) showed a correlation between genetics and creativity (3-4 genes are responsible for creative traits), between experience and creativity, and between writing ability and creativity. Some research showed that while an average level of intelligence is important to creativity, there seems to be no connection between being highly intelligent and being highly creative (Andreasen, 2006). Research on cognitive ability as it relates to creativity is not well documented, but there seem to be some similarities between cognition and creativity. The longitudinal studies on cognitive thinking abilities appear to indicate that there is an experience factor that affects the cognitive level in a positive way (Csikszentmihalyi, 1996). Experience has been shown to positively affect creativity as well (Sternberg, 2007;

Csikszentmihalyi, 1996). Developmental psychologists who research cognitive abilities indicated that maturity factors into cognitive abilities (Kegan, 1994; King & Kitchener, 1994; Perry, 1970; Piaget, 1955). Some theorists on creativity reported that there is a maturity component to being creative, as well (Csikszentmihalyi, 1998). Vandervert, Schimpf, & Liu (2007) described how the brain's frontal lobes and the cognitive functions of the cerebellum collaborate to produce creativity. Vandervert et al.'s explanation relies on evidence that all processes of working memory are routed through the cerebellum and inner brain. The cerebellum, consisting of about 60-100 billion neurons, is also widely known to adaptively model all bodily movement and involuntary, non-thinking functions (Foer, 2007). Creative insight, or the ah-ha experience, appears to be triggered in the temporal lobe. Since the cerebellum adaptively controls all movement and all levels of thought, and transmits stimulus responses to areas of the brain that govern emotion (hippocampus, amygdala), Vandervert's theory helps explain creativity and innovation in sports, art, music, mathematics, and thought in general.

The military leaders recognize that creativity and cognitive complexity are important and are making efforts to improve their training and education to meet this need (*Command and General Staff College campaign plan*, 2005; Joint Forces Staff College, 2007). In addition, there seems to be scientific research in cognitive psychology, genetics and neuroscience that support a connection between creativity and cognitive development.

Theoretical Rationale

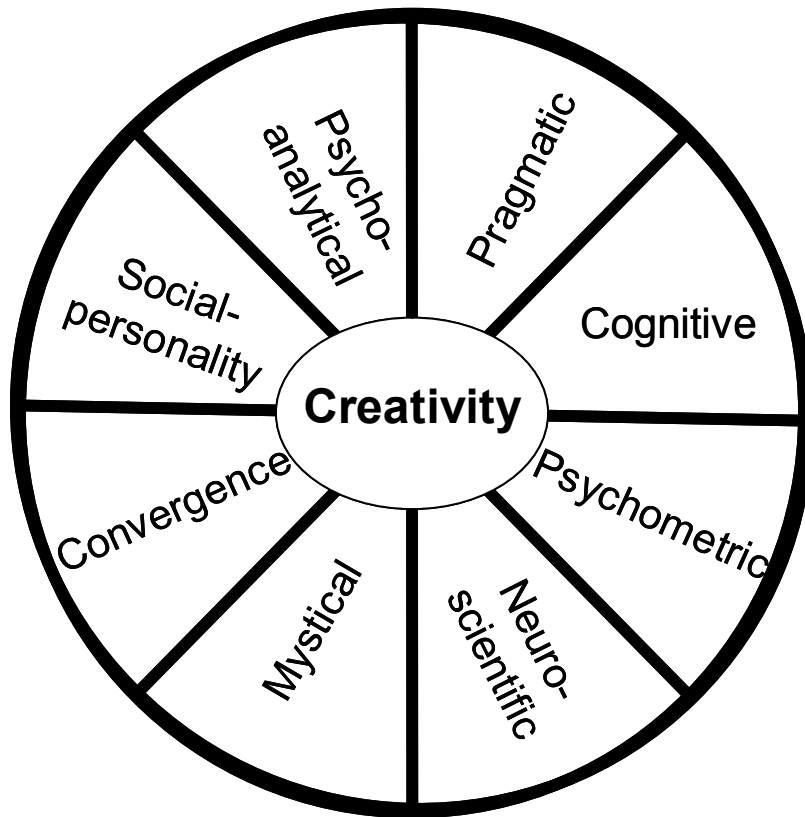
Creativity

There are more than 60 different definitions of creativity in the psychological literature. Csikszentmihalyi (1996) defined creativity as a mental process involving the generation of new ideas and concepts, or new associations between existing ideas and concepts in order to produce something deemed useful by the field and / or peers. Torrance (p. 4, 1974a) defined creativity as "a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies: testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results." Many definitions of creativity do not involve the utilitarian part of Csikszentmihalyi's or Torrance's definition that places emphasis on the creation being practical. In the business world, the above

definitions could be used for the term *innovation*, since innovation implies the praxis of the new ideas. Teresa Amabile (1996), a professor at Harvard School of Business, suggested that all innovation begins with creative ideas, and that creativity by individuals and teams is a starting point for innovation. According to Amabile (1996), the products of creative thought, sometimes referred to as divergent thought, are usually considered to have both originality and appropriateness.

When considering the study of creativity it is important to understand the approaches and how they are different (Sternberg, 1996). Although intuitively a simple phenomenon, creativity is in fact quite complex (Runco, 2007). It has been studied from the perspectives of behavioral psychology, social psychology, cognitive science, philosophy, business, and art, among others (Figure 1.1). The studies have covered everyday creativity, exceptional creativity, and even artificial creativity; there are new studies that examine creativity in artificial intelligence (Boden, 1999). Like many phenomena in psychology, there is no standardized approach or measurement technique.

Figure 1.1 Approaches to Creativity



Mystical Approaches

Perhaps the earliest accounts of creativity were based in the divine intervention of some supreme being. In this vein, a creative person was seen as an empty vessel that the divine would fill with inspiration. These mystical approaches made it much harder for scientific approaches to be heard. These early thoughts on creativity were promulgated by Plato and early Christian philosophers (Boorstin, 1992).

Pragmatic Approaches

According to Sternberg (2007), pragmatists are concerned with first creating creativity, then understanding it. The lack of scientific rigor in the pragmatic approach causes potential damage to the science of creativity (Sternberg, 2007). Most of these practitioners are after

commercial success, like Edward DeBono and his “Thinking Hats” (Runco, 2007). While the pragmatic approaches to creativity receive considerable publicity (and money), they do not approach creativity from a scientific manner. They have little understanding of how something works; just that their technique is successful on some level (Sternberg, 1999).

Psychoanalytic Approaches

Proposed by Freud, a psychoanalytic approach to understanding creativity suggests that creativity arises as a result of frustrated desires for fame, fortune, and love (1958). This could be considered the first major 20th century approach to the study of creativity. Based on the theory that creativity arrives from a tension between the conscious and the unconscious, early psychoanalysts proposed this point of view (Sternberg, 1999).

Social-personality Approach

Teresa Amabile's hypothesis was that in social-psychological experiments, creativity was a product of intrinsic motivation (1996). Some researchers have taken a social-personality approach to the measurement of creativity (Sternberg, 1999). In these studies, personality traits such as independence of judgment, self-confidence, attraction to complexity, aesthetic orientation, and risk-taking are used as measures of the creativity of individuals. Other researchers related creativity to a trait called openness to experience (Csikszentmihalyi, 1998).

Psychometric Approaches

Even though other researchers, conducted psychometric studies, it is commonly accepted that Guilford initiated the psychodynamic study of creativity during his address to the APA conference in 1950 (Sternberg, 2007). Guilford also performed important work in the field of creativity, drawing a distinction between convergent and divergent production, commonly renamed convergent and divergent thinking (Basseches, 1984; Runco, 1991). Convergent thinking involves aiming for a single, correct solution to a problem, whereas divergent thinking involves creative generation of multiple answers to a set problem (Basseches, 1984). Divergent thinking is sometimes used as a synonym for creativity in psychology literature. Other researchers have occasionally used the terms *flexible thinking* or *fluid intelligence*, which are roughly similar to (but not synonymous with) creativity (Cattell, 1971). Borrowing on Guilford's ideas, Torrance developed the Torrance Tests of Creative Thinking (1974). Torrance, known as

the Father of Creativity, dedicated nearly 60 years of his life to research in the field and has impacted educational practices even today (Millar, 2001). His research became the framework for gifted education. The Torrance Tests of Creative Thinking helped call into question the theory that IQ tests alone are enough to measure intelligence (Millar, 2001).

Convergence of Approaches

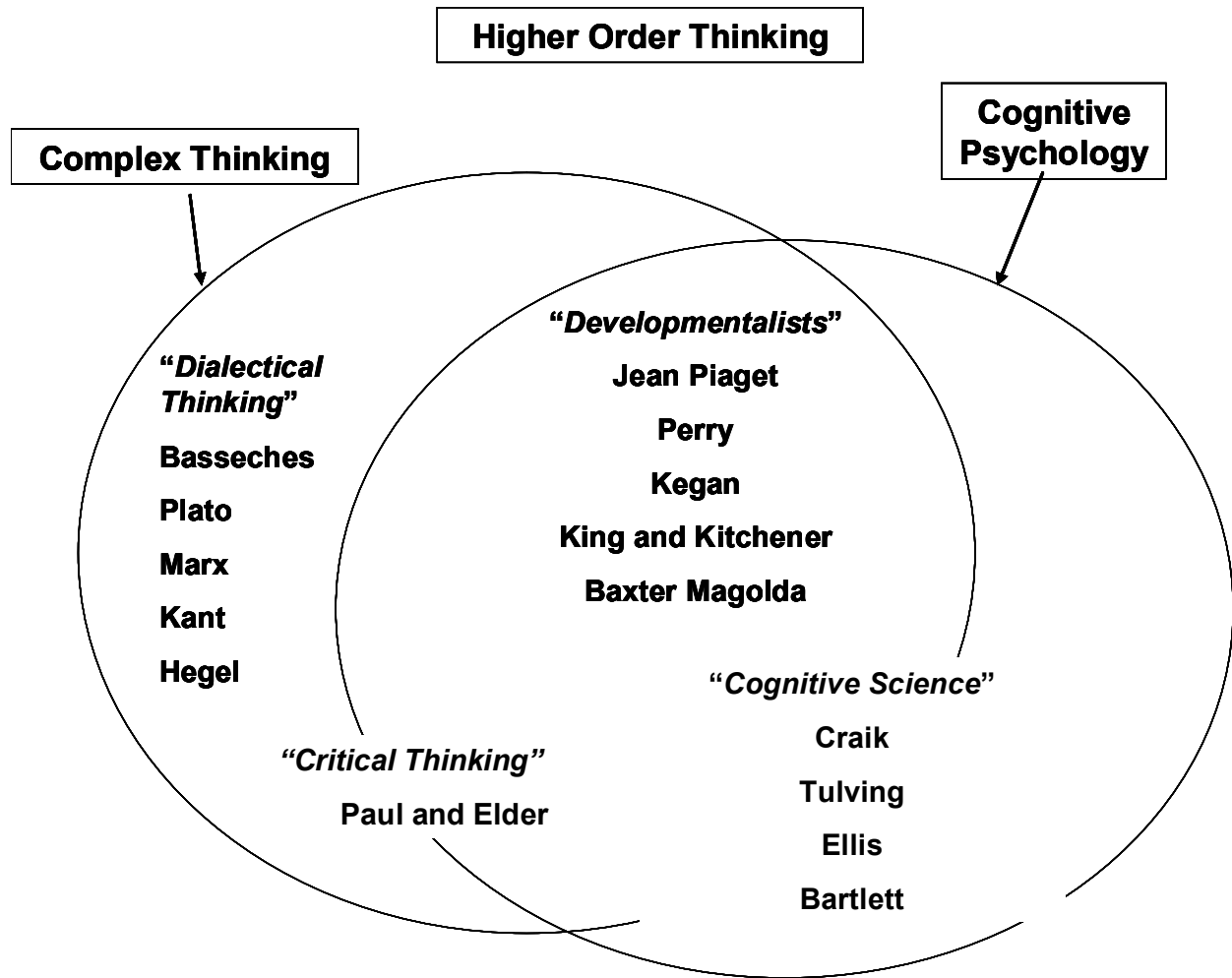
Most scientists agree that while there may be several different approaches to the study of creativity, there is a convergence (Sternberg, 1999). There appears to be a confluence of intrinsic motivation, domain-relevant knowledge and abilities, and creativity-relevant skills. These skills may include a cognition that involves coping with complexities, knowledge of heuristics, and a work style characterized by concentrated effort. Csikszentmihalyi (1998) took a different systems approach and highlighted the interaction of the individual, the domain, and the field. Sternberg (1997) put forth another theory on creativity. He said that people invest in creative ideas and that these people are willing to take smaller risks for huge gain.

While there appear to be several different approaches to creativity, there also seems to be a multitude of approaches to thinking and how it applies to cognitive psychology (Sternberg, 1999).

Higher Order Thinking, Complex Thinking and Cognitive Psychology

Throughout history, philosophers, politicians, educators, and many others have been concerned with the art and science of astute thinking. Some identified the spirit of inquiry and dialogue that characterized the golden age of ancient Greece as the beginning of this interest (Piiro, 2004). Others pointed to the Age of Enlightenment, with its emphasis on rationality and progress (Rorty, 2004b). In the twentieth century, the ability to engage in careful, reflective thought was viewed in various ways: as a fundamental characteristic of an educated person, as a requirement for responsible citizenship in a democratic society, and more recently as a necessary skill to be able to solve problems in an increasingly complex world. While there are several areas within psychology that look at higher order thinking, it appears that developmental psychologists not only believe that these skills can be developed, but also that instruments exist to determine levels of cognitive development (Rorty, 2004b).

Figure 1.2 Higher Order Thinking: Complex Thinking and Cognitive Psychology



Higher order thinking incorporates several fields and definitions of thinking under its umbrella (Figure 1.2). Included are:

Critical thinking: The process of determining the authenticity, accuracy, or value of something; characterized by the ability to seek reasons and alternatives, perceive the total situation, and change one's view based on evidence. This is also called logical thinking and analytical thinking (Elder & Paul, 2002).

Dialectical thinking: Dialectical thinking consists of an exploration of contradictory possibilities that results in cognitions that reduce cognitive dissonance (Basseches, 1984).

Complex thinking: The transition from simple thinking to more complex operations, from observable to abstract dimensions, from an emphasis on working with known materials to creating or inventing new materials (Puccio, Murdock, & Mance, 2007).

Cognitive psychology also examines thinking.

Cognitive psychology: A perspective with psychology that focuses on the realms of human perception, thought, and memory (American Psychological Association, 2007). Cognitive psychology is different from other psychological approaches in two key ways. First, it accepts the use of the scientific method, especially the use of quantitative analysis. Second, it acknowledges the existence of internal mental states, unlike behaviorist psychology (Finke, Ward, & Smith, 1996). Within cognitive psychology are theorists who are interested in the formation of thought, or cognitive science. Craik (1943), for example, developed the theory of mental models. Other cognitive psychologists expressed interest in the development of higher order thought; the developmental psychologists.

Developmental psychology, also known as human development, is the scientific study of progressive psychological changes that occur in human beings as they age (American Psychological Association, 2007). Originally concerned with infants and children, the field expanded to include adolescence, and more recently, aging and the entire life span. One model that has been used to measure cognitive complexity in college students is William Perry's scheme.

William Perry

In the 1960s and 70s William Perry developed a cognitive psychology model for the development of cognitive complexity among college students. He postulated in *Forms of Intellectual and Ethical Development in the College Years: A Scheme* (1970, 1998), that students progress through four major stages: dualism or received knowledge, multiplicity or subjective knowledge, relativism or procedural knowledge, and commitment or constructed knowledge.

Students in the dualism stage believe there is a single right answer to all questions. Knowledge is perceived as truth delivered by professors. Dualistic thinkers resist thinking independently, drawing their own conclusions, stating their own points of view, and discussing ideas with peers; these are senseless tasks because they believe teachers should deliver the facts.

They are especially uneasy when teachers disagree with each other. They believe that learning involves taking notes, memorizing facts, and later depositing facts on exams.

Students in the multiplicity stage, also known as subjective knowledge (Belenky et al., 1997), believe that knowledge is just an opinion and that students and faculty are equally entitled to believe in the value of their own opinions. They may disagree with faculty criticism of their work, attributing it to arrogance and the faculty's inability to recognize the value in alternative perspectives (Perry, 1970, 1981, 1998).

Students at the relativism stage, or procedural knowledge, recognize that opinions are based on values, experiences, and knowledge. All proposed solutions are supported by reasons. Some solutions are better than others, depending on context. The student's task is to learn to evaluate solutions.

Students at the commitment stage, or constructed knowledge (Belenky et al., 1997), integrate knowledge learned from others with personal experience and reflection. They can argue their perspective and consider the merit of alternative arguments by evaluating the quality of the evidence. Knowledge is constructed through experience and reflection. These students view faculty as having better-informed opinions in their areas of expertise and as being able to teach students techniques for evaluating the quality of evidence underlying conclusions (Perry, 1970, 1998). Perry's work strongly impacted how people looked at a college student's cognitive development.

William S. Moore's Expansion of Perry's Theory of Cognitive Development

According to Moore, there has been increasing interest in assessment and instrumentation research on Perry's model (Baxter Magolda, 1992; Belenky et al., 1997; Moore, 1994). In Perry's original research, interviews were used to assess students' cognition (Moore, 1989). In the original studies by these researchers, an open-ended format of questioning was used (Moore, 1989). While interviews continue to be a rich and valuable means of assessing the Perry scheme, they are limited in their usefulness due to time constraints, complexity and costs involved in making transcriptions, and analyzing data. For that reason, Moore (1989) developed a quantitative instrument of evaluating student learning, the Learning Environments Preference or LEP.

In this research, the instrument used to evaluate cognitive development was the LEP. Moore stated that there seems to be a growing emphasis on thinking processes that are an outcome of the colligate experience. In his research he poses several questions: What is meant by thinking processes? How can they be taught? How can they be measured? (Moore, 1994).

The LEP is an objective, recognition-task instrument (Moore, 1989). This measurement was initially designed and validated based upon the qualitative research done on Perry's (1970, 1981, 1998) intellectual and ethical development model. Moore found that there was a high correlation of scores on the LEP to the levels in Perry's scheme.

Moore said that while he suggested that the Perry schema may be a good tool for evaluating a students' thinking ability, teachers are not taught how to create the type of learning environments that facilitate the development of complex thinking (Moore, 1994). Moore cited work by several other people, to include Baxter Magolda (1992) and King, Kitchener, Davison, Parker, and Wood (1983), to support his hypothesis. How do teachers create these learning environments? Moore presented several methods for developing thinking abilities, including developmental instruction (Moore, 1994) and the notion of learning environments (Moore, 1989). In addition to developing thinking abilities, he also stated that teachers should place emphasis on ethical development, just as Perry (1970, 1981, 1998) mentioned in his own research.

According to Moore, the Cognitive Complexity Scores on the LEP roughly correspond with levels in the Perry scheme as follows (Moore, 1989):

200-240: position 2: *Dualism* (either/or thinking): Students in this stage believe there is a single right answer to all questions. Knowledge is truth delivered by professors. Dualistic thinkers resist thinking independently, do not draw their own conclusions, do not state their own points of view, and do not discuss ideas with peers openly. People in this stage are especially uneasy when teachers disagree. They believe that learning involves taking notes, memorizing facts, and regurgitating these facts on exams.

241-284: transition 2/3

285-328: position 3: *Multiplicity* (subjective knowledge): People in this stage believe that knowledge is just an opinion, and students and faculty are equally entitled to believe in their own opinions. They may get upset when their work is criticized because they fail to acknowledge the professor's point of view and experience.

329-372: transition 3/4

373-416: position 4: *Relativism* (constructed knowledge): Individuals at this level recognize that opinions are based on values, experiences, and knowledge. They can argue their perspective and consider the alternative arguments by evaluating the quality of the evidence. Knowledge is *constructed* through experience and reflection. These students view faculty as having better-informed opinions in their areas of expertise.

417-460: transition 4/5

461-500: position 5: *Commitment in Relativism* (taking a stand): A student may reaffirm or reject old beliefs, but either way, the decision is based on a *conscious* consideration of alternatives as opposed to the blind acceptance of the Dualist. These people can commit to their opinions, ideologies, values, and interests. Recognition of the fallibility of their choices, acceptance of responsibility for their consequences, and willingness to accept others' right to their own choices is a characteristic of this stage.

Theoretical Approaches Followed in This Study

For the purposes of this research, the study follows two approaches to attempt to identify a relationship between cognitive development levels and creativity levels. First, for two reasons the researcher adopted the perspective of the developmental psychologists Perry and Moore. Both of these reasons are not only important to this research, but important to the belief that that the Department of Defense can develop the cognitive thinking levels in its officers.

1. Perry and Moore demonstrated that cognitive abilities can be developed (Perry, 1970; Moore, 1989).
2. Perry and Moore believed that cognitive levels can be measured (Perry 1998; Moore, 1989).

The second approach that this research adopted is the psychometric approach to understanding and measuring creativity as defined by Torrance. There are also two important reasons for adopting this approach. As above, both of these reasons are important not only to determining a relationship between cognition and creativity in this research, but also for the Department of Defense to develop the levels of creativity in its officer corps.

1. Torrance demonstrated that creativity levels can be developed (Torrance, 1974; Millar, 2004; Sternberg, 2006; Runco, 2007).

2. Torrance asserted and demonstrated that creativity levels can be measured (Torrance 1974; Millar, 2004; Sternberg, 2006; Runco, 2007).

Problem Statement

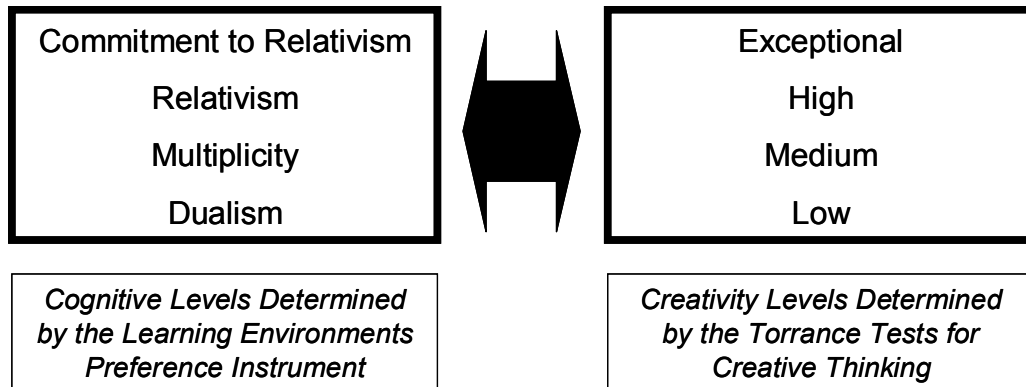
There has been little research to support a correlation between creativity and cognitive complexity. By grouping blocks of instruction in complex thinking (i.e. the development of cognitive complexity) and creativity, there is an assumption by academic institutions that these two concepts are related (*Command and General Staff College campaign plan*, 2005).

The Department of Defense trains soldiers to function in ambiguous environments, equips them to perform in the face of uncertainty, and deploys them to operate in situations for which they lack training. Therefore, the military says that it needs soldiers who have the ability to think at a complex level and are creative. Joint service officers are educated at the Joint Forces Staff College in Norfolk, VA, where classes on creativity and complex thinking are taught together. The JFSC is one of the academic institutions where the Department of educates its military officer corps.

Purpose Statement

The purpose of this study was to investigate whether a relationship exists between cognitive development levels and the level of creativity in field grade officers in at the Joint Forces Staff College (Figure 1.3). The researcher used two nationally normalized tests and compared the results: the Learning Environments Preference (LEP, 2008) and Torrance Tests of Creative Thinking (TTCT, 2008).

Figure 1.3 Correlation between Cognitive Development and Level of Creativity



Research Questions

The following questions guide this study:

1. What is the nature of the correlation between the level of cognitive complexity and the level of creativity in field grade officers at the Joint and Combined Warfighter School? (Primary research question)
2. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and the branch of service (Army, Navy, Air Force, Marine Corps)? (Secondary research question)
3. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and combat experience? (Secondary research question)
4. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and gender? (Secondary research question)
5. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and education level? (Secondary research question)
6. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and age? (Secondary research question)

Design of the Study

This quantitative study used a non-experimental, correlational design (Campbell & Cook, 1979, Campbell & Stanley, 1963; Patton, 2002). In this non-experimental design, no treatments were applied. The reason for this research design was to explore the phenomena that occur between the level of cognitive complexity and the level of creativity. This study described the relationship between the two variables measured, cognitive complexity and creativity. In addition, this study analyzed the effects that age, rank, gender, combat experience, and education level have on cognitive complexity and creativity. Correlational studies were used to look for relationships between variables (level of cognitive complexity and level of creativity). A correlational study has three possible results: a positive correlation, a negative correlation, and no correlation. While correlational studies can suggest that there is a relationship between two variables, they cannot prove that one variable causes a change in another variable. In other words, correlation does not equal causation.

Procedure

The researcher administered the Learning Environments Preference (LEP) and then the Torrance Tests of Creative Thinking (TTCT) to each group of subjects. The researcher provided a brief presentation to the subjects on the research conducted, how the research applied to the subjects, and the significance of the study. In addition, the researcher described the two instruments that were used to the sample population, and in general, set conditions for success in administering the two instruments and for achieving reliable and valid results (Moore, 1989; Torrance, 2008b and f). The students must visualize their ideal learning environment in order to achieve the best results on the instruments.

The Instruments

Learning Environments Preference (LEP)

The Learning Environments Preference (LEP) was developed by Moore (1991). According to Moore, the LEP takes approximately 45 minutes to complete. The LEP focuses on levels 2 through 5 in Perry's scheme (Perry, 1970, 1981, 1998). This instrument describes a consistent pattern of increasing intellectual complexity. The LEP consists of 65 items divided into five different content domains:

1. View of knowledge/learning
2. Role of the instructor
3. Role of the student/peers
4. Classroom atmosphere/activities, and
5. Role of evaluation/grading

The LEP was developed to evaluate college undergraduate level of development; however, Moore (1991) found that the instrument worked equally as well with graduate students, such as the ones at the Joint and Combined Warfighter School. The LEP is grounded in qualitative data collected on the Perry scheme over the last decade (Baxter Magolda, 1992; Moore 1989). The LEP reflects a numerical index along a continuous scale on cognitive complexity from 200-500, roughly analogous to the Perry 2 (200) to 5 (500) positions. According to Moore (1989, 1991), it is best to think of the LEP score as a more general indicator of increasing cognitive complexity. The LEP validity and reliability studies indicate that the LEP accurately measures cognitive development (Moore, 1989). The LEP was chosen because it is the most widely recognized paper and pencil instrument for evaluating Perry's scheme; it has validity and a high amount of reliability.

Torrance Tests of Creative Thinking (TTCT)

The Torrance Tests of Creative Thinking (TTCT) were developed by Dr. Ellis Paul Torrance and his associates in 1966. They have been renormalized six times, in 1974, 1984, 1990, 1998, 2002, and 2007 (Torrance, 2008a, 2008c). There are two forms (A and B) of the TTCT-Verbal and two forms (A and B) of the TTCT-Figural. Scholastic Testing Service, Inc. holds the copyright for the TTCT and provided a 2007 norms manual for the test. The TTCT can be administered as individual or group tests and can be used for kindergarten through adult. They require 30 minutes per test of working time, so speed is important, while artistic quality is not required to receive credit.

The TTCT was a part of a long-term research program emphasizing classroom experiences that stimulate creativity. Torrance (1966, p. 6; 1972, 1974a, 1974b) defined creativity as:

A process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies: testing and retesting

these hypotheses and possibly modifying and retesting them; and finally communicating the results.

Torrance (1966, 1974a, 1974b) has suggested the following uses for the test:

1. To understand the human mind and its functioning and development.
2. To discover effective bases for individualizing instruction.
3. To provide clues for remedial and psychotherapeutic programs.
4. To evaluate the effects of educational programs, materials, curricula, and teaching procedures.
5. To be aware of latent potentialities.

Although there have been several revisions of the TTCT-Figural manual, the test itself has remained unchanged. The first edition in 1966 measured *fluency*, *flexibility*, *originality*, and *elaboration*, which were taken from the divergent-thinking factors found in Guilford's Dimensions of Aptitude (Guilford, 1959; Torrance, 1966).

The scoring was as follows:

1. *Fluency*: the number of interpretable, meaningful, and relevant responses to stimulus.
2. *Flexibility*: the variety of categories of relevant responses.
3. *Originality*: the responses which are unexpected, unusual, unique or statistically rare.
4. *Elaboration*: the addition of pertinent details. (Torrance, 1966).

The TTCT is translated into 35 languages (Flavell, Miller, & Miller, 2002). It has become highly recommended in the educational field, is the most widely used test of creativity (Colangelo & Davis, 1997), and has the most references of all creativity tests. The standard administration and scoring procedures (Davis & Rimm, 1994), as well as the development and evaluation (Colangelo & Davis, 1997), have made the TTCT especially useful for identifying gifted and talented students. Therefore, the TTCT appeared to be a good measure not only for identifying and educating the gifted, but also for discovering and encouraging everyday life creativity in the general population.

The Population

The population sampled was field grade officers of military ranks of O-4 and O-5 in the Joint and Combined Warfighter School (JCWS) at Norfolk, VA, during class number 08-02, 14 January, 2008, to 21 March, 2008. There were 250 officers attending this course ($N = 250$). The JCWS, also known as Joint Professional Military Education II, educates military officers and national security leaders in strategic and operational level planning, introduces the complexity of a rapidly changing environment, and challenges the students' ways of thinking with a focus on joint, multinational, and interagency issues (Joint Forces Staff College, 2007).

The Sample

The researcher sampled this population during the 14 January, 2008, to 21 March, 2008, JCWS class. The researcher received authorization from the Joint Forces Staff College Commandant to survey seven 18-person staff groups ($n = 126$) (See Appendix G). Each staff group was purposefully constructed by the Staff College. The administrators at the Staff College attempted to have equal representation of branch or service, gender, race and ethnicity, and experience in each of the staff groups. Therefore, each one of the staff groups that is sampled is a purposefully selected cluster within the Staff College.

Recording and Scoring of Data

The LEP is a copyrighted test. Approval to use the LEP was gained from Dr William S. Moore and The Center for the Study of Intellectual Development. In addition, The Center for the Study of Intellectual Development is the sole repository for scoring of the LEP. The Center provided a summary sheet including all demographic information, position sub-scores, and the overall CCI (Cognitive Complexity Index) score, plus basic summary statistics as requested by the researcher (see Appendix A).

The TTCT can either be scored by the researcher or by the Scholastic Testing Service. In order to increase the validity and reliability of the analysis, the researcher elected to have the Scholastic Testing Service score the TTCT Figural and Verbal tests (Torrance, 2008d, 2008e) (see Appendix A).

Data Analysis

The SPSS statistical software package was used for all statistical analyses on the data set. The data sets from the seminars were combined into one master data set for the sample. Descriptive statistics, including frequencies, measures of central tendency, and measures of variation were used to analyze the diversity of the sample as to gender, combat experience, branch of service, and education level, with respect to the scores on the LEP and TCTT. Kendall's Tau statistic was used to analyze the correlation between creativity and cognitive complexity. Kendall's Tau, controlling for the variables of age, branch of service, gender, combat experience, and rank, was used to analyze the nature of the correlation between creativity and cognitive complexity. The researcher then conducted partial correlations between cognitive complexity, creativity and the aforementioned variables of age, combat experience, rank, gender and branch of service (see Appendix H).

Significance of the Study

To date, research has shown that there is little association between IQ and creativity (Sternberg & Grigorenko, 2001; Torrance, 1979). Research has indicated that creativity is linked to genetics, that creativity can be taught, and that creativity is linked to social context (Amabile, 1996; Grigorenko, 2007; Venter, 2007). There is a dearth of research that examined cognitive development with creativity (Finke et al., 1996). This research is significant from the standpoint that the military considers cognitive development and creativity to be two attributes of higher order thinking that are important to performing and excelling in ambiguity in the contemporary operating environment (Clark, Cracraft, & Ferro, 2006). The Secretary of Defense Gates considers creativity an important quality for officers (Miles, 2008). Intermediate level academic institutions such as the Army's Command and General Staff School attempt to improve its students' levels of creativity and cognitive complexity (Command and General Staff College campaign plan, 2005). In addition, there is little scientific evidence to suggest that there is a correlation between creativity and cognitive complexity. Therefore, this exploratory study on the relationship that is present between the measured levels of cognitive complexity and the measured levels of creativity is an important first step in understanding how to improve creativity and cognitive complexity.

Limitations of the Study

As an exploratory study, this research had inherent limitations, many of which will be addressed in future research. The following limitations apply to this research:

1. The results are not generalizable.
2. The results of this study are exploratory.
3. The results of this study are limited by the accuracy and the truthfulness of the participants' self-reported data.
4. The results of this study are limited by the features of the LEP and the TTCT instruments.
5. The results do not show causality, only a relationship between variables.
6. The results are bound by the definitions that were used to explain cognitive complexity (from the LEP; Moore, 1989) and creativity (from the TTCT; Torrance, 1974).

Definition of Terms

For the purposes of this study, the following definitions were used:

Abstractness of titles. Refers to the ability to produce good titles involves the thinking processes of synthesis and organization and is used in the scoring of the TTCT-Figural (Torrance, 1974).

Cognitive complexity. (a) refers to the extent to which individuals differentiate and integrate an event and are able to analyze a situation of many constituent elements, and then explore connections and potential relationships among the elements. These individuals are multidimensional in their thinking, which includes the evolution in the beliefs about what constitutes knowledge, truth, and fact, and the role of authorities in defining and conveying knowledge; and that how a person defines these beliefs falls into one of four major periods: dualism, multiplicity, relativism, commitment to relativism. (b) A scale used in the LEP reflecting a single numerical index along a continuous scale of cognitive complexity from 200 to 500, roughly analogous to Position 2 (200) to Position 5 (500) (Kurfiss, 1977; Moore, 1989; Perry, 1970).

Cognitive psychology. A school of thought in psychology that examines internal mental processes such as problem solving, memory, and language (Piaget, 1971).

Commitment to relativism. This is a stage of development in which individuals begin to realize that they must make choices and commit to solutions and ways of life (Perry, 1970).

Creativity. A process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies: testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results (Torrance, 1974).

Developmental psychology. This is the scientific study of progressive psychological changes that occur in human beings as they age (Piaget, 1971).

Domain-relevant skills. Knowledge and skills that contribute to creative performance in a given domain, but do not contribute to performance in other domains (Amabile, 1996).

Dualism. A stage of development in which individuals may resist learning information that challenges their established beliefs (Perry, 1970).

Education level. For purposes of this research, either a bachelor's, master's, or doctorate degree.

Elaboration. The process of enhancing ideas by providing more detail. Additional detail and clarity improves interest in and understanding of the topic (Torrance, 1974).

Field grade officer. Air Force, Army, and Navy officers in the grade of Major, Lieutenant Colonel, Colonel, Lieutenant Commander, Commander, and Captain (Navy) in the department of defense (Bonn, 2007, see Appendix I).

Flexibility. Refers to the production of ideas that show a variety of possibilities or realms of thought. It involves the ability to see things from different points of view and to use many different approaches or strategies (Torrance, 1974).

Fluency. Refers to the production of a great number of ideas or alternate solutions to a problem. Fluency implies understanding, not just remembering information that is learned (Torrance, 1974).

Joint and Combined Warfighting School.: This institution educates military officers and other national security leaders in joint, multinational, and interagency operational-level planning and warfighting. It instills a primary commitment to joint, multinational, and interagency teamwork, attitudes, and perspectives. Joint and Combined Warfighting School is commonly

referred to as Joint Professional Military Education, phase II (JPME II) (Joint Forces Staff College, 2007)

Multiplicity. A stage of development in which individuals may argue that their answers are just as valid as an authority figure's answers for a subjective topic (Perry, 1970).

Originality. Involves the production of ideas that are unique or unusual. It involves synthesis or putting information about a topic back together in a new way (Torrance, 1974).

Relativism. A stage of development in which individuals begin to realize that valid disciplinary reasoning methods exist (Perry, 1970).

Resistance to premature closure. Refers to the ability of a creative person to remain open and delay closure long enough to make the mental leap that makes possible original ideas. This is measured by the individual's tendency to close the incomplete figures immediately with straight or curved lines or not (Torrance, 2008d).

Summary

This research was purposed to discover if there was a relationship between cognitive complexity and creativity. Research has shown that while having intelligence is important to levels of creativity, being intelligent does not guarantee that you will be creative (Amabile, 1996; Sternberg, 2007). Some previous research indicated that having a high cognitive level was an important factor of being highly creative, but being a *relativist* does not mean that one is highly creative (Sternberg, 1999).

Teaching people how to think is important. Teaching people how to think and how to be creative at the same time intuitively makes sense (Costa, 2001). However, one must think critically about this association. If there is no correlation between cognitive abilities and creativity, does it make sense to teach these two concepts at the same time? If there is no correlation, perhaps students would be better served and would learn more if the two subjects were taught separately.

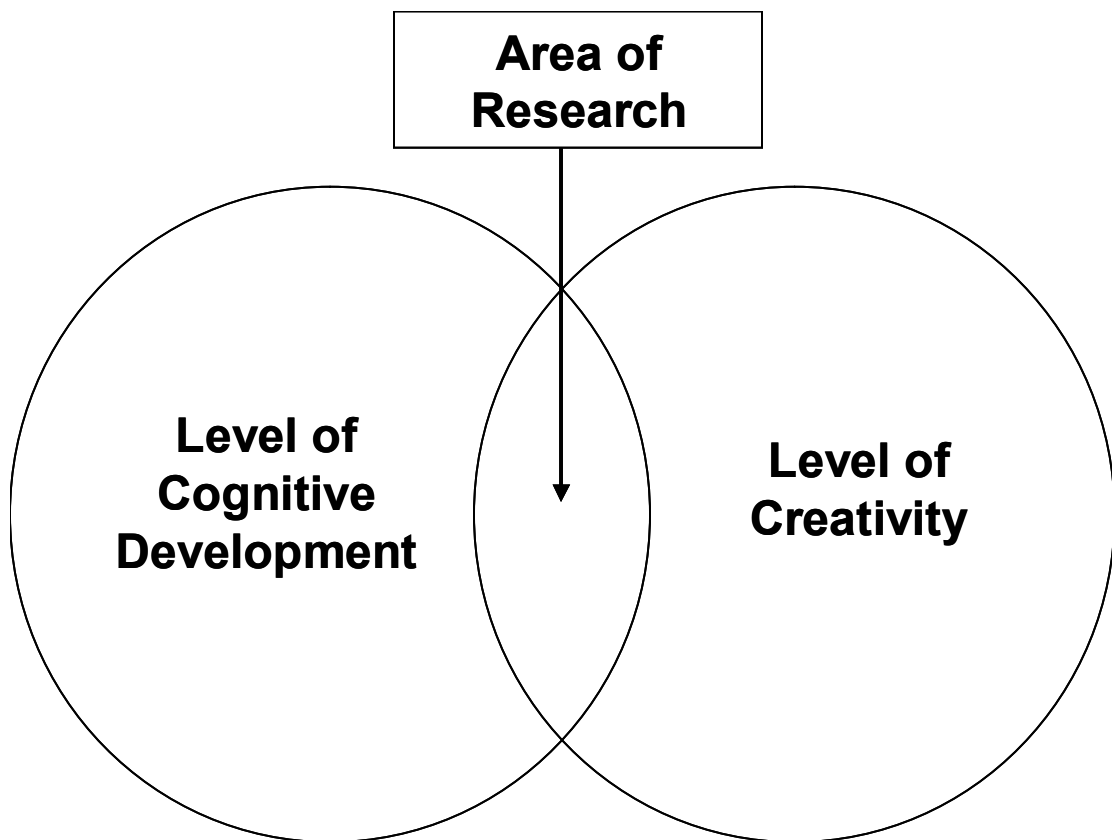
The military has problems that it needs to solve. These problems are complex and not well structured. Solving these problems requires comfort in ambiguity, resourcefulness, cognitive abilities such as critical thinking, and creativity (Clark, 2006). It is important to understand the nature of cognition and creativity and how they relate to each other, if the military is going to prepare to meet the challenges ahead.

CHAPTER 2 - Literature Review

Introduction

This chapter discusses the fields of creativity and cognitive complexity, and how they relate to each other. A history of the study of creativity is presented. An overview of the major perspectives in the field of creativity in the twentieth and twenty-first centuries is discussed, in addition to discussing major theorists in each time period. Cognitive complexity and cognitive psychology are introduced. Research on how the military has studied creativity and cognitive complexity is reviewed. The chapter concludes with research that makes a neuro-scientific connection between cognitive complexity and creativity (Figure 2.1).

Figure 2.1 Area of Research

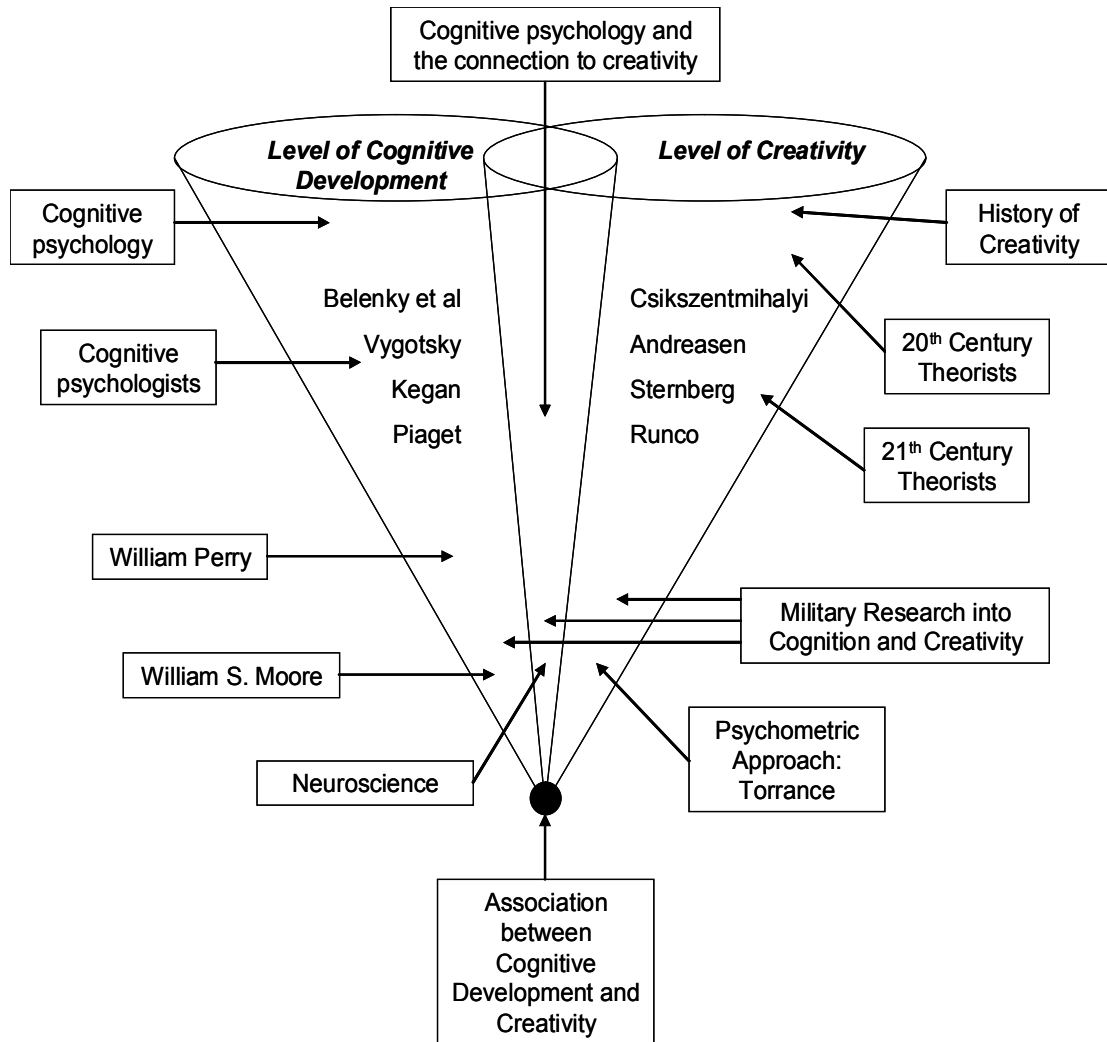


Preliminary research began with published books on creativity and cognitive psychology and included a document search for journal articles and dissertations related to cognitive development and creativity. The research then moved to the attendance of conferences, seminars,

and workshops on the subjects of cognitive development, creativity, and neuroscience. The final stage of the research culminated with first-person interviews with the major current researchers in the fields of creativity and cognitive development.

Much of the literature regarding the development of creativity and use of creativity techniques indicates wide acceptance, at least among businesses and academics (Runco, 2007). That being said, there is a down side to creativity in that it represents a quest for autonomy apart from the constraints of social norms. In other words, encouraging creativity supports a departure from society's existing perceived values. Expectation of conformity runs contrary to the spirit of creativity. Nevertheless, employers increasingly value creative skills (Pukalos, 2000). Creativity is one of those interesting fields that mirrors the very topic it studies; just as creativity is complex and multifaceted, so too are the approaches to its study. There are case study, laboratory, statistical, meta-analytic, and philosophical approaches. There are studies concerned with social, developmental, personality, motivational, emotional, cognitive, and neuroscience factors. There are emphases on extraordinary creativity, as might be shown by noted artists, composers, scientists, or inventors and on more normative aspects of creativity inherent in how ordinary people solve the problems of everyday life. There are basic research approaches directed at increasing our theoretical understanding of the phenomena, and more applied approaches examining the manifestation and enhancement of creativity in business, educational, science, and social policy. This is not an exhaustive list, but helps to illustrate the richness of the field (Figure 2.2).

Figure 2.2 Taxonomy of Literature Review



How Does This Research Contribute to the Field?

Until recently, creativity had not been the subject of serious study among cognitive scientists, experimental psychologists, and neuroscientists (Sternberg, 2002). This research attempted to identify the cognitive processes and structures that contribute to creative acts and products. What was central to this research was that it tied in the traditional areas of human cognition and cognitive psychology with levels of creativity. This research was unique in that it examined several types of mental processes. First, it identified processes that set the stage for creative insight and discovery (i.e. curricula in academic institutions). Second, it distinguished

cognitive complexity from creativity through a correlation of the two domains. Third, it attempted to identify covariates to explain cognitive complexity and creativity in people. Fourth, it distinguished the creative cognitions that emanate from thinking, from an idea for the idea itself (cognition). In adopting the creative cognition approach, this research was more concerned with identifying the conditions under which creative discovery was likely to occur (cognitive levels, maturity, age, experience). Moreover, if this research can help train and educate military officers to make better decisions, then the research was worthwhile.

Creativity

Origins

The ancient Greeks had no terms exactly corresponding to the term “creativity.” In Rome, authors wrote that not only poets, but also painters were entitled to the privilege of daring whatever they wished (Andreasen, 2006). Andreasen reported that Latin had a term for creating, *creatio*, and had two expressions for making; *facere* and *creare*. A fundamental change came in the Christian period: *creatio* came to mean God's act of making something from nothing (Albert & Runco, 1999). Another shift occurred in more modern times. The Renaissance had a sense of its own independence, freedom, and creativity, and sought to give voice to this sense of creativity. By the 18th century and the Age of Enlightenment, the concept of creativity was appearing more often in art theory and was linked with the concept of imagination. In the 19th century, art was regarded as creative. At the turn of the 20th century, discussion of creativity began in the sciences and in nature. In the late 19th and early 20th centuries, early accounts of the creative process were pioneered by theorists such as Wallas (Andreasen, 2006). However, the formal starting point for the scientific study of creativity, from the standpoint of psychological literature, is generally considered to have been Guilford's 1950 address to the American Psychological Association, which helped popularize the topic (Guilford, 1950; Sternberg & Lubart, 1999).

A History of Creativity

This background survey of literature attempts to describe the historical changes in the concept of creativity, which can be contrasted with efforts to describe the historical changes in the evolution of creativity. This section shows that the early conceptualizations of creativity and

research were, in themselves, creative acts. One must understand not only the evolution of creativity but the origination of modern research methodology, and the two fit together, in order to understand the nature of the present day concept of creativity. Understanding this should help to understand some aspects of creativity in history. One aspect is the significance of historical process lies as much in their timing as in their content. Another aspect is that institutions and identifiable groups are critical in selecting important strands of possibilities already in the work and minds of creative people. And lastly that the relevance of ideas and events becomes apparent only when there is a group of engaged, articulate persons deeply concerned, empathizing with the same problem. When viewed this way, history is experimental (Albert & Runco, 1999).

Much of what is known about current day creativity in Western history can be found by tracing the concepts of research and creativity through the past and by examining the linkage to the late 19th century, 20th, and 21st centuries, after centuries of being separate. The necessary first step in doing a survey of information was to have the concept of research in mind. The next step was to believe that research regarding human nature (modern day psychology) was important and as feasible as doing research regarding nature (classic scientific method). In addition it is important to understand that the concept of creativity has its own history, language, and intellectual path that were, for two centuries, independent of the institutionalization and conceptualization of research (Andreasen, 2006; Sternberg, 1988, 1996; Sternberg & Grigorenko, 2001).

The invention of scientific research was the outgrowth of intriguing questions about the nature of science and the belief that it was possible for men and women to understand the laws of nature through the use of experimentation (Galton, 1874). Early on, few debated the nature of creativity and even less on how this could be investigated (Galton, 1869).

Until recently, there was a very small number of professional articles and books on the topic of creativity, however, nearly every major 20th century psychologist (i.e. Freud, Piaget, Rogers, and Skinner) took creativity seriously and explored what it meant to be creative (Piaget, 1971; Freud, 1958). The growing professional interest in a subject can be seen by the growing number of professional articles on the subject. Creativity research now has its own scholarly journal, *Creativity Research Journal*, and creativity attracts increasing attention in not only the academic world but the business world as well. In 1996 alone, three articles on creativity

research appeared in the *American Psychologist* (Eisenberger & Cameron, 1996; Schneider, 1996; Sternberg & Lubart, 1996).

Early on, the understanding of creativity and view that influenced our thinking throughout the centuries, as the concept of genius, was originally associated with mystical powers of protection and good fortune (Albert & Runco, 1999). When Greeks placed emphasis on an individual's Daimon (guardian spirit), the idea of genius became passé and was progressively associated with an individual's abilities. Creativeness took on a social value, and by the time of Aristotle, had an association with madness and frenzied inspiration, a view that reappeared during most of the 19th and first half of the 20th centuries (Galton, 1869). Examination of the succeeding Roman view of genius finds two additional characteristics given to it: it was seen as a male capacity, and an illustrious male's creative power that could be passed on to his children (Harrison, 2004).

Some scholars say that the earliest Western conception of creativity was the Christian biblical story of the Creation given in Genesis from which came the idea of the "artisan" doing God's work on Earth (Boorstin, 1992; Nahn, 1956). This belief reflected the significant difference between Western and Eastern thinking about the goal of creativity and the participant's role in the process. For the Hindus (1500-900 BC), Confucius (551-479 BC), and the Taoists and Buddhists, creation was a kind of discovery. The early Taoists and Buddhists emphasized natural cycles of harmony, regularity, and balance; therefore, the idea of the creation of something *ex nihilo* (from nothing) had no place in the universe of yin and yang. Originality, which has become a contemporary marker for creativity, was not an early attribute of creativity (Child, 1972; Rorty, 2004b).

These assumptions were not seriously challenged for almost one thousand years. Even though Chaucer used the word "create" as early as 1393, the conceptual outline of creativity remained relatively faint and at times was even lost until most of the major philosophers (e.g., Hobbes (1588-1679), Locke (1632-1704)) of the Enlightenment were able to move beyond a concern with imagination, individual freedom, and society's authority in human affairs (Tuck, 2004).

Throughout most of the years of the Renaissance and the many philosophical discussions that took place, scientific works were known for their power of discovery and disruption of cultural and religious norms. Three of the Western world's greatest scientists—Copernicus (1473-

1543), Galileo (1564-1642), and Newton (1642-1727)—had given proof to this (Albert & Runco, 1999; Garber, 2004). Yet it took more than their example. It required a widespread change in perceiving the laws of the physical world working in the here and now and a recognition of how this lawfulness related to human existence and the social purposes it could serve.

A growing interest in science is evidenced by the fact that the word *research*, meaning a *deliberate scientific inquiry*, entered the English language in 1639, soon after the appearance of the word *researcher* in 1645 (Rorty, 2004a). Although ideas related to creativity had been relatively unchanged for 200 years from 1500, other changes taking place were exceptionally productive ground for the idea of research. It was around this time that science and scientific thinking took form as the paramount instruments of discovery and models for thinking about the physical world (Bronowski, 1951).

At the same time, a more far-reaching intellectual upheaval, known as the English Enlightenment, was gathering convincing force, and an increasing consistency of new attitudes and concern was emerging. Francis Bacon's (1605) *Advancement of Learning* became an accepted argument for the importance of empirical investigation. The Enlightenment's widespread truth-seeking and social opposition to authority (i.e. religion, monarchies and political oppression) grew in parallel to science's own opposition to the ideas of these authorities. These arguments included a mounting belief in the necessity of such freedoms as speech, the press, and life of the individual (Gay, 2004).

Science and scientific research were codified when the Royal Society was chartered by Charles II in 1662, with John Locke (1632-1704) as one of its early members. The fact that there were already two similar academies in France and Italy with none of the influence of the Royal Society tells us just how great a fit there was between science and England. At this point research had acquired the purpose of discovery. It is not simply that the Royal Society quickly became a meeting place for the otherwise strewn scientists and mathematicians. The historical prominence of this is significant, but the underlying force was that the Royal Society institutionalized recognition of their work. Among the Royal Society's formal mandates was that the scientists' peers review their work. Members were required to not only publish their work, but to do so in the Society's *Philosophical Transactions* (Andreasen, 2006). Private individually sponsored papers were no longer distributed; furthermore, it was stated that if others were to be able to

understand and use the individual's work, then the work was deemed unscientific. Personal eccentric language was to be avoided.

Of all its requirements, probably the most influential was the requirement to publish one's results in the Society's *Transactions*, which soon gave the Royal Society a great power over the reputations of its members (Albert & Runco, 1999). Just how important was this authority was demonstrated in the arbitration of the prolonged and bitter debate between Robert Hooke and Isaac Newton (Albert & Runco, 1999). The expectation to publish for merit while driven primarily by individual's motivation was itself institutionalized by the Society in two ways: by the Society's accountability to science as an institution, and by its importance on the publication of scientific results (1999). The requirement accompanied a second goal, which was to make evident the power of science. Two practical consequences resulted from these institutional requirements. One was the condensed amount of individuality shown in published papers. While encouraging individualism and genius, the Society had instituted a set of requirements that effectively stripped scientific contact of many signs of individuality. The second consequence was to change the Society's early concern with individuality—which, ironically, some 17th and 18th century writers believed was the main component of genius and creativity—to the Royal Society's explicit importance on the lawfulness of nature and the discovery of practical benefits from science (Andreasen, 2006). These benefits underscored the weight of natural laws and the magnitude of scientific experimentation in the physical world.

Several more intellectual developments would take place before the present day concept of creativity could develop. During the last half of the 18th century, natural science's belief in *natural law* became widely accepted. For English and European artists, poets, writers, and philosophers, there were two questions that had been endlessly discussed throughout the 18th century: What were the limits of freedom of thought? What was the social and political significance of that freedom? Until these questions were answered, there could be no clear understanding of what creativity was, much less what it could do. The most noteworthy distinctions made in the mid 1700s were the idea of creativity and those of genius, originality, talent, and formal schooling (Boden, 2004). To appreciate how difficult it was to develop the notion of creativity, remember that it had taken several generations of writers, philosophers, and artists to even come close to the conception. Their difficulty can be seen in that their pondering

of imagination led as early as 1730s to the phrase “creative imagination.” By the late 1700s, “imagination itself” was accepted as a governing artistic creativity (Engell, 1981, pp. vii-viii).

As tedious and peripheral as they were at times, the debates through the 18th century nevertheless eventually came to four fundamentally acceptable distinctions that were to become the basis of our present day thought about creativity: (a) genius was separated from the supernatural, (b) genius was a potential in every individual, (c) talent and genius were to be distinguished from one another, (d) potential and exercise sometimes depended on politics (Albert & Runco, 1999).

By now there were two models that incorporated many of the important arguments and practical observations related to research and creativity; one of these models—rational science—bears on science’s power and on the practical use of research. The other model can be called ideology of creativity. It had to do with the social significance and potential dangers of originality and individualism in the context of compliance to authority and upholding of social order (Albert & Runco, 1999; Galton, 1874, 1869).

While natural science and practical inventors were busy demonstrating what human reason and English ingenuity could do, it was numerous practical inventions and their ever-increasing power that eventually led to unforeseen and unintended consequences (Anderson, 2004). The unpredicted widespread movements resulting from natural science was too obvious to overlook, in spite of natural science’s century-old belief that physical nature was governed by rational and intelligent laws. The spreading of the doctrine of individualism quickly became the accepted explanation for and source of fear over these consequences. In order to understand one of these consequences, it is necessary to recognize that they were not new; they had been an intractable concern during most of Adam Smith’s lifetime (1723-1790) (Muller, 1995). Smith knew that consequences that were unintended and unanticipated happened often, as did his Swiss contemporary Jean-Jacques Rousseau. In over 100 years, this new identity, which marked artists’ sense of deviance and their deliberate defiance of middle class society, would be used by charlatans as justification to put down artists in general and genius and creativity specifically (Albert & Runco, 1999; Nahn, 1956). Although both reactions occurred at the same time, their consequences for research and creativity had different time tables, which were not coordinated until the end of the 19th century, through the achievements of Galton (1883) and Freud (1953a, 1958, 1961).

Adam Smith was one of the first to recognize the need for the science of human behavior. His *Wealth of Nations* (1776) was a deliberate effort to bring together many reasons for social science; it is “almost an encyclopedia of the effects of unintended consequences in human affairs...the consequences of action are often different from the intentions which motivate actors” (Muller, 1995, p. 85). His point was that not all consequences are good or bad, but some are unintended. Eight years after Smith’s death, there was a major intellectual and practical development that contributed to the establishment of a social science: the publication of Malthus’ *Essay on Population* (1798). His research was as pragmatic as nonphysical science research would be until Galton. Forty years later a phrase in *Essay on Population* that he used to explain the social disruptions—“struggle for existence”—provided Darwin (1859) with the explanation for natural selection that he was trying to put forth. This particular idea helped to organize Darwin’s efforts, and *The Origin of the Species* added new evidence that human existence was indeed precarious, subjected to unintended and unplanned shifts in natural selection. The intellectual breakthrough of the 19th and early 20th centuries’ understanding of creativity was implied in the role that Darwin gave to adaptation in survival. Freud, who read Darwin and met Galton, was to incorporate this idea in his theory of defenses which related to creativity (Albert, 1996; Ellenberger, 1970; Freud, 1910/1953b, 1908/1958). Because evolution occurs without foresight, adaptations get their start as unexpected effects that opportunistically are picked up by selective forces in the environment. At this time, what was presented was the possibility of research on creativity if adaptations were observed in controlled everyday conditions (Darwin, 1859).

One of Darwin’s correspondents on the theory of evolution was Galton, who had two competing interests. One was the study of individual differences; the second was a deliberate program of eugenics. Whether or not he was aware of it, Galton was following Adam Smith’s footsteps in his wish to protect society from inadvertent social consequences. Eugenics was Galton’s program to minimize the uncertainty in natural selection as it might specifically affect Britain. These two research interests led to his most direct contribution to research on creativity—his choice of eminence-achieving families as examples of heredity adaptability. From this came the selection of eminent persons as subjects of obvious creativity and the practical use of statistics. Galton provided evidence for the ideas that genius was unconnected from the supernatural and was a potential in every individual, because according to him, ability is distributed throughout populations (Galton, 1869).

Galton was not the only person interested in creativity at this time. He was the strongest force at applying empirical methods. Sternberg (2007) suggested that one obstacle to research on creativity over the years was the tie between creativity and mysticism, in the sense that creativity might have mystical origins. Galton, through his research, dispelled some of this belief.

After her review of the 19th century research, Madelle Becker (1995) concluded that in spite of the differences in the characteristics of the authors and the articles, the themes of that century were not similar to those of the 20th century. She stated that a number of 19th century authors concentrated on five basic questions: What is creativity? Who has creativity? What are the characteristics of creative people? Who should benefit from creativity? Can creativity be increased through conscious effort? No one doubts that these are important questions for understanding creativity, but at the time, only Galton (1883) made real progress in suggesting how they could be answered.

In 1877, James defined genius as essentially creative and apparent when there is a divergence from regular methods of thought and action (Becker, 1995). James' depth of understanding was seen in his 1896 public lectures in which he demolished the wild assertions that were made by amateur, self-appointed social critics and medical experts regarding the exceptional mental states (James, 1896/1992). The idea of divergent thinking was formulated by James, who understood the rarity of ideational complexity.

As more people recognized the importance of creativity and quest for the enhancement of this attribute, it became more researched.

Twentieth and Twenty-first Century Research

In the early 1900s, measuring individual capacities for intelligence became a research of many psychologists. In fact, by 1904 Binet and Spearman were doing empirical investigations on intelligence tests with Binet's test, including items that he believed required imagination and what is now called divergent thinking (Becker, 1995; Brody, 1992; Fields, 2006; Willerman, 1986). In the U.S., one of the early pioneers into the study of IQ was Terman, as evidenced by the titles of his works, including the five-volume *Genetic Studies of Genius* (1925, 1926, 1930, 1947, and 1954). The purpose of his research was to influence the American educational system to accept a system of meritocracy. Catherine Cox's dissertation (1926) documented a study that was based on Terman's method of investigating IQ. Her most famous conclusion of her findings

addresses the connection between high IQ, motivation, and divergent thinking stating that youths who achieved eminence were characterized not only by high intellectual traits, but also by persistence of motivation and effort, confidence in their abilities, and great strength of force of character (Albert & Runco, 1989). It is difficult to think of any other 20th century researcher prior to WWII who equaled Cox's contributions. After WWII, the focus of study would shift from ego psychology to the study of personalities, values, talents, and IQs of exceptionally creative men and women. Robert Albert and Mark Runco (1989) found that above IQ 115, creativity and IQ constitute two more or less independent sets of abilities from late childhood on to adulthood. In the 1950s and 60s, the study of creative personality was the hot topic. Later, researchers such as Steven Dudek and William Hall shifted from the study of creative personalities to a comparison of participants with their creative counterparts (1991). Over the last 50 years research on creativity merged an interest in creative persons with empirical methods and a feeling for the humanity and dignity of subjects, out of which came respect for acknowledged (recognized by a group of peers) as well as everyday creativity.

As the first half of the twentieth century concluded, Joy Paul Guilford (1950), in an address to the American Psychiatric Association, challenged psychologists to pay attention to what he found to be a neglected and extremely important attribute, creativity. He reported that less than 0.2% of entries in psychological abstracts up to 1950 focused on creativity. Since Guilford's address to the American Psychological Association in 1950, there has been an upward trend in the amount of research conducted. As scientists recognized that creativity was not some sort of mystical thing that couldn't be quantified, more emphasis was placed on not only identifying it and figuring out how it works, but also how to cultivate it. However, as late as between 1975 and 1994, this number increased only slightly to 0.5%, according to research by Robert Sternberg and Todd Lubart (1999). This area of psychology and adult education, although important, is still not a well researched topic.

From a social psychology perspective, Teresa Amabile presented her *Creativity in Context* (1996), in which there appeared to be a dearth of studies in this area. Her theory presented that creativity is connected to task motivation and domain-relevant skills, which are both connected to internal and external stimuli, and to storage of relevant knowledge, memory recall, and response, which lead to creative outcomes.

Robert Sternberg has written extensively on creativity. In the introduction to *The International Handbook of Creativity* (2006), he emphasized that research in the field can be generalized into five areas. First, “Creativity involves thinking that is aimed at producing ideas or products that are relatively novel and that are in some respect, compelling” (p. 2). This assertion is similar to the definition offered by Csikszentmihalyi in Chapter 1 of this dissertation. Second, “that creativity is neither wholly domain specific nor wholly domain general” (Sternberg, 2006, p. 2). He stated that the potential to be creative may rely in the acquisition of domain specific knowledge, or individuals may be creative all on their own. Third, creativity can now be measured on a scale. Fourth, creativity has been shown to be developed. Finally, creativity is not generally rewarded in society (Sternberg, 2006). How is this reflected in how governments and societies manifest creativity? Sternberg said that while governments may want creative citizens, their reactions to creativity do not support this. Internationally, creativity is particularly challenging to study. Because creativity is so formidable to grasp, it is particularly arduous to even study. Because creativity is not mainstream research (such as developmental psychology) it is difficult to gain support for research.

Sternberg proposed that one cannot become a major researcher in creativity by just studying creativity but one must first establish research in another field, and then move to creativity. Sternberg first studied intelligence and had made recent contributions to the field through editions of the *Intelligence* (2004) and *The Nature of Creativity: Contemporary Psychological Perspectives* (1997). In the *Handbook of Creativity* (1999), he attempted to depart from the connections of creativity to cognitive psychology and intelligence by creating a collection of works that were entirely devoted to the field of creativity. He made a connection between creativity and intelligence in *Wisdom, Intelligence, and Creativity Synthesized* (2007), where he cited both implicit theories (practical problem solving abilities, non-entrenchment, and reasoning ability) and explicit theories (performance components, knowledge-acquisition components, novelty skills, and practical skills). Sternberg criticized the commercialization of creativity as hurting the field. Researchers like Edward DeBono and the Thinking Hats theory used creativity to gain economically, which is at the expense of the academic prestige of the field (Piirto, 2004). In Sternberg’s collection of essays in *Creativity: From Potential to Realization* (2006), he attempted to assist readers by trying to define what it means to be creative, who is

creative, and why. Several of the preeminent authors on creativity contributed to this work, to include Dr. Mark A. Runco.

Dr. Mark Runco stated that creativity is difficult to define and measure, but in his article, “Everyone has Creative Potential,” he stated that creativity should be viewed as a “kind of self-expression” (2006). He further asserted that creativity requires motivation, a large knowledge base (which at times might be considered an inhibitor), and a bit of risk taking. In Runco’s textbook, *Creativity: Theories and Themes: Research, Development, and Practice* (2007), he codified the field by making creativity a class that can be taught from a textbook, much like what was done at the Buffalo State in New York, which offers bachelor’s and master’s degrees in creativity.

Dr. Gerard Puccio, from Buffalo State, co-authored *Creative Leadership: Skills that Drive Change*, with Mary Murdock and Marie Mance (2007). They attempted to build on the research of Sternberg and others and introduced a practical application of creativity as applied to leadership. They advanced several foundational principles as well as thinking tools for leaders. In the conclusion of the book, they presented additional factors for leaders to consider. Research and application, such as this done by Puccio, is important to consider, especially from a military context where theories that are not practical have no place.

Dr. Nancy Andreasen explained her study on creativity in her book, *The Creative Brain: The Science of Genius* (2006). She approached creativity from both psychological and medical perspectives. As a student of Renaissance literature, Andreasen demonstrated how the creative process works on a psychological level from factors of environment, education, and social context. As a medical doctor, Andreasen presented a compelling case for creativity from biological, chemical, and neuroscience perspectives.

The Creative Mind: Myths and Mechanisms (2004) is Margaret Boden’s book on her study of creativity and how computers can help to understand it. She used Douglas Hofstadter’s computer program COPYCAT to demonstrate her use of analogy and creativity. In addition, she used Harold Cohen’s computer painting program AARON to show how computers can be used as a tool to express creativity.

Dr. Jane Piirto devoted an entire chapter in her book, *Understanding Creativity* (2004), to addressing the reliability and validity of testing creativity; specifically, the Torrance Test of Creative Thought (TTCT). The TTCT is a well recognized test of creativity that has been used to

assess creativity in grades K-12, but has been found to be equally as applicable to older folks, as well. While the TTCT was developed in 1970, Piiro (2004, p. 380) cited Meeker as stating, “We have to start somewhere, don’t we?” Piiro showed that the TTCT is both reliable and valid when assessing creativity in people.

Sternberg, James Kaufman, and Jean Pretz (2002) after a review of the literature written on creativity and intelligence, found that there were three general conclusions: creative people tend to have above-average IQ’s, above an IQ level of 120, the correlation between IQ scores and creativity appears to weaken, and the relationship between creativity and IQ depends very much on what aspects of intelligence and creativity are measured. In addition to these findings, Sternberg et al. put forth a propulsion model of creativity that outlined eight different kinds of creative contributions, categorized on the basis of their relationships to domains.

Other subject matter experts in the field of creativity include Dr. Michael Dickmann and Nancy Stanford-Blair, with their book on *Connecting Leadership to the Brain* (2002). In their book, Dickmann and Stanford-Blair demonstrated how the prefrontal cortex processing of information in the occipital lobes affects creativity. Arthur Costa edited *Developing Minds: A Resource Book for Teaching Thinking* (2001). In this book, Costa and others presented, in Section IX, “Strategies for Teaching Thinking,” several techniques for teaching dialectical thinking and creativity.

Creativity research is diverse in its context and approaches. There are two major journals (*Creativity Research Journal*, edited by Mark Runco, and the *Journal of Creative Behavior*) devoted exclusively to creativity research and theory, as well as a myriad of other journals that publish articles and research on the field of creativity. Furthermore, there is a division of the American Psychological Association devoted to creativity (Division 10, Psychology of Aesthetics, Creativity, and the Arts, that publishes a journal that features creativity research, *Bulletin of Psychology and the Arts*). Scores of books about creativity research are published every year; and creativity research is a major topic at many psychology and educational conferences every year. As such, other areas outside of academia are now interested in creativity, to include the military.

What is the Field?

Creativity (or creativeness) is a mental process involving the generation of new ideas or concepts, or new associations between existing ideas or concepts (Weisberg, 2006; Csikszentmihalyi, 1996). Numerous definitions of creativity inundate psychological literature (Finke et al., 1996). Creativity is often contrasted with innovation in the business world. Creativity is typically used to refer to the act of producing new ideas, approaches, or actions, while innovation is the process of both generating and applying such creative ideas in some specific context; innovation could be considered the praxis of creativity (Runco, 2007). For example, Harvard School of Business professor, Teresa Amabile (1996) suggested that while innovation begins with creative ideas, creativity by individuals and teams is a starting point for innovation; the first is necessary, but not the only requirement for innovation. While creativity is addressed in many fields, the concentration of this study focused in the areas of creativity as it relates to psychology, and to the linkage between cognitive development (from the fields of cognitive and developmental psychology) and creativity, as defined by Torrance in *Torrance Tests of Creative Thinking* (1974).

What Are the Approaches?

Although intuitively a simple phenomenon, creativity is in fact quite complex. It has been studied from the perspectives of behavioral psychology, social psychology, psychometrics, cognitive science, philosophy, and business. The studies have covered everyday creativity, exceptional creativity, and even artificial creativity. Like many phenomena in science, there is no single authoritative perspective or definition of creativity. Like many phenomena in psychology, there is no standardized measurement technique. As mentioned in Chapter 1, there are numerous approaches to include: mystical, pragmatic, psychoanalytic, psychometric, social-personality, neuro-scientific, and a multitude of convergence approaches (Andreasen, 2006; Piirto, 2004).

Recent Research on Creativity and Their Approach

Pragmatic

In a 1999 article, Runco summarized a longitudinal study of exceptionally gifted boys, with particular emphasis on findings involving their creative potential. The longitudinal

investigation began two decades earlier with two exceptionally gifted samples of adolescents ($n=54$) and their parents. These samples represented equivalent levels of ability but different areas or domains of talent. One group was exceptionally gifted in math and science (i.e., age 11 Scholastic Assessment Test mathematics scores in the 99th percentile); the other a high-IQ group (mean IQ = 155). Data were collected from the boys and their parents. Runco summarized group differences in expectations of independence, California Psychological Inventory scales, and divergent thinking test scores. In addition to group differences, notable findings included the strong relation between mothers' expectations for their sons' independence and the divergent thinking of the sons and the high flexibility scores of the exceptionally gifted samples on the CPI (Runco, 1999).

Runco and Robert Albert (2005) conducted a follow-up investigation as part of the ongoing longitudinal investigation of exceptional giftedness. Creative potential was assessed using various tests of divergent thinking. California Psychological Inventory profiles indicated that both groups of adolescents had low scores on the Well-Being scale, and there was some indication across several scales of low sociability. The parents' profiles were relatively uniform, and differences between the two groups were slight. Correlational analyses indicated that several scales from the CPI were associated with creativity scores of the adolescent boys (Runco & Albert, 2005).

Free production of variability through unregulated divergent thinking holds the promise of effortless creativity, but runs the risk of generating only quasi-creativity or pseudo-creativity if it is not adapted to reality, according to David Cropley (2006). Therefore, creative thinking seems to involve two components: generation of novelty via divergent thinking and evaluation of the novelty via convergent thinking. In the area of convergent thinking, knowledge is of particular importance: it is a source of ideas, suggests pathways to solutions, and provides criteria of effectiveness and novelty. The way in which the two kinds of thinking work together can be understood in terms of thinking styles or of phases in the generation of creative products. In practical situations, divergent thinking without convergent thinking can cause a variety of problems, including reckless change. Nonetheless, care must be exercised by those who sing the praises of convergent thinking: Both too little and too much is bad for creativity (Cropley, 2006).

Psychoanalytic

In 2005, Jason Meneely and Margaret Portillo examined domain-specific relationships between creative personality traits, cognitive styles, and creative performance in design. Design students ($n = 39$) completed the Adjective Check List (ACL) and the Herrmann Brain Dominance Instrument (HBDI) to gauge personality and cognitive style, respectively. The ACL was scored using Domino's Creativity Scale (ACL-Cr) to identify creative personality traits. The sample also completed a design task that was evaluated for creativity using the Consensual Assessment Technique (CAT). Findings indicated that participants showing flexibility between cerebral, limbic, right, and left modes of thinking had significantly higher mean scores on creative personality than did those who exhibited a more entrenched cognitive style. Creative personality traits (ACL-Cr) significantly predicted creative performance on the design task. While cognitive style (HBDI) did not predict creative performance, flexibility between styles was significantly correlated to the creative personality. In sum, individuals exhibiting adaptable thinking appeared to possess the flexibility necessary to design creatively and potentially transform the domain with original and imaginative solutions (Meneely & Portillo, 2005).

Psychometric

The Creative Achievement Questionnaire (CAQ), developed by Shelly Carson, Jordan Peterson, and Daniel Higgins is a self-report measure of creative achievement that assesses achievement across ten domains of creativity. It was designed to be objective, empirically valid, and easy to administer and score. The study by Carson et al. established test-retest reliability ($r = .81, p < .0001$) and internal consistency reliability ($\alpha = .96$) in a sample of 117 undergraduate students. In addition, predictive validity of the CAQ against artist ratings of a creative product, a collage ($r = .59, p < .0001, n = 39$) was established. Furthermore, convergent validity was established with other measures of creative potential, including divergent thinking tests ($r = .47, p < .0001$), the Creative Personality Scale ($r = .33, p < .004$), Intellect ($r = .51, p < .0001$), and Openness to Experience ($r = .33, p < .002$). The study established validity between the CAQ and both IQ and self-serving bias. Carson et al. (2005) also examined the factor structure of the CAQ. A three-factor solution identified Expressive, Scientific, and Performance factors of creative achievement. A two-factor solution identified an Arts factor and a Science factor.

A study by Chi Hand Wu, Yim Cheng, Hoi Man Ip, and Catherine McBride-Chang (2005) explored performances on three types of creativity tasks: real-world problem, figural, and

verbal (Torrance, 1974) in 22 sixth-grade students and 22 university students from Hong Kong. As compared to sixth-grade students' scores, university students' scores, both quality and quantity, were significantly higher on the real-world problem and significantly lower on the figural task. On the verbal task, the groups did not differ. Results are interpreted in terms of an interaction between task structures and students' knowledge bases. Knowledge enhances one's performance in knowledge-rich creativity tasks, whereas functional fixedness may occur in knowledge-lean tasks.

Creativity is commonly held to emerge from an interaction of the person and the situation. In a study of creativity by Sam Hunter, Kristina Bedell-Avers and Michael Mumford, studied the situational influences that are commonly assessed by using climate measures. In the present effort, a meta-analysis was conducted to examine 42 prior studies in which the relationships between climate dimensions, such as support and autonomy, and various indices of creative performance were assessed. These climate dimensions were found to be effective predictors of creative performance across criteria, samples, and settings. It was found, moreover, that these dimensions were especially effective predictors of creative performance in turbulent, high-pressure, competitive environments. The implications of these findings for understanding environmental influences on creativity and innovation were discussed (Hunter, Bedell-Avers, & Mumford, 2007).

Deniz Hasirci and Halime Demirkan (2007) studied the essential components of creativity—persons, processes and products. These were investigated inside a creative environment by deeply focusing on the cognitive stages of the creative decision making process. Mental imagery and external representation were considered as the implicit parts of creativity for enhancing design studio process. An experiment was conducted with 15 subjects who designed the public area of a train as the task in design. Observation, protocol analysis, and rating scales were used as assessment tools. Considering the components of creativity, it was found that the highest correlation was between process and overall creativity. Person and product followed process, respectively. However, no significant relationship was observed between imagery and creativity in design process. Three-dimensional representations were found to lead to more creativity compared to two-dimensional depictions (Hasirci & Demirkan, 2007).

An article in 2005 by Bonnie Cramond, Juanita Matthews-Morgan, Deborah Bandalos, and Li Zuo updated information about the TTCT by reporting on predictive validity data from

the most recent data collection point in Torrance's longitudinal studies. First, Cramond et al. outlined the background of the tests and the changes in scoring over the years. Then he detailed the results of the analyses of the 40-year follow-up on the TTCT, resulting in a structural equation model, which demonstrated the validity of the TTCT for predicting creative achievement 40 years after its administration. Finally, he provided a rationale for the relevance of the test in schools today (Cramond et al., 2005).

Divergent thinking tests are often used to estimate the potential for creative problem solving. According to Runco, Gayle Dow, and William Smith, scores on these tests may, however, reflect a kind of experiential bias. Similar biases once plagued IQ tests, the idea being that scores reflect the individual's background and information in long-term memory as much as ability. The investigation reported attempted to assess the role of experience, knowledge, and memory in divergent thinking by comparing two kinds of tasks. One was a standard divergent thinking task (i.e. create a list for uses for a shoe, or uses for a brick, or uses for a newspaper). The other allowed a number of responses but required that the examinee produce factual, knowledge-based responses. A second objective was to compare standard- and knowledge-based ideation with tasks that shared one domain (i.e., transportation) with tasks that did not share a domain. Results indicated that there was a statistically significant correlation between the two types of tasks but only when they shared one domain. This was confirmed with product-moment correlations ($r = .37, p < .025$) and a canonical correlation ($Rc = .69, p < .008$). The correlations were not significant when the tasks represented different domains. It is interesting to note that both the knowledge-based and the standard divergent thinking tasks were unrelated to grade point average, which supported their validity (Runco, Dow, & Smith, 2006).

Specific domains of talent have been increasingly recognized by educators. The intent of Runco and Jill Nemiro's study in 2003 was to review and integrate work on moral creativity. Special attention was directed to points of agreement found in the literature and to implications for studies of creativity and education. This was not merely a review, however; they made every effort to compare and contrast the various theories and highlight the controversies in the area. One of the more surprising controversies involved the concept of adaptation, which is often associated with creativity and would seem to have great potential for addressing creativity in the moral domain and the resolution of moral dilemmas. They also explored the arguable theories that writing is the more useful domain for the resolution of creative dilemmas, that art for art's

sake is ethical, and that general knowledge should be targeted in moral education. They began and ended with the question, why is creativity in the moral domain more important now than ever before (Runco & Nemiro, 2003)?

There is disagreement whether creativity is a unidimensional or multidimensional trait. The dimensionality of creativity is important to understand the mind's cognitive functioning, thus aiding the development of human potential. Much of this dimensionality debate is related to the TTCT. Kyung Hee Kim conducted a study in 2006, where she used confirmatory factor analyses from 500 grade-6 students and several factor models to demonstrate dimensionality. The findings of this study suggested that the TTCT consists of two factors, intelligence and personality, rather than a single factor, contrary to the majority of research on this subject.

Social-Personality

Romina Jamieson-Proctor and Paul Burnett (2004) described a theoretical underpinning and development of a measurement instrument that provided teachers with a tool to observe the personal creativity characteristics of individual students. The instrument was developed by compiling a list of characteristics derived from the literature to be indicative of the personal characteristics of creative people. The list was then reduced by grouping like characteristics to 9 cognitive and dispositional traits that were considered appropriate for elementary students. The 9-item instrument was administered in 24 classrooms to 520 year 6 and year 7 students. The results indicated that the Creativity Checklist has high internal consistency and is a reliable measurement instrument.

Randolph Cooper and Bandura Jayatilaka (2006) conducted a study on how creativity-reducing extrinsic motivation generally has been associated with rewards tied to task performance. However, their study also presented evidence that creativity-affecting motivation may result from extrinsic rewards that are not tied to task performance. This type of motivation may be due to feelings of obligation. A research model was developed that examined how such obligation motivation differs from extrinsic and intrinsic motivations in terms of influencing creativity. Given the importance of groups in organizations, the focus was on motivation and creativity within interacting groups. A laboratory experiment was performed that involved groups determining requirements for an academic information system. The results supported a conceptual differentiation between the three types of motivation.

Neuro-Scientific

It was proposed that creativity and innovation are the result of continuously repetitive processes of working memory that are learned as cognitive control models in the cerebellum. In addition, these cerebellar control models consist of multiple-paired predictor models within the MODular Selection and Identification for Control (MOSAIC) and hierarchical MOSAIC (HMOSAIC) cerebellar architectures that explore and test problem-solving requirements. When resulting newly formed predictor/controller models are fed in to the model they more efficiently control the operations of working memory, and they lead to creative and innovative problem solving, including the experiences of insight and intuition. Within this framework, Larry Vandervert, Paul Schimpf, and Huang Liu analyzed three of Einstein's classic autobiographical accounts of creative discovery. It was concluded that the working memory/cerebellar explanation of creativity and innovation can begin to tie together three things: first, behavioral and neuro-imaging studies of working memory, second, behavioral, clinical and neuro-imaging studies of the cognitive functions of the cerebellum, and third, autobiographical accounts of creativity. It was suggested that newly developed electromagnetic inverse techniques will be a necessary complement to functional brain imaging studies to further establish the validity of the theory (Vandervert et al., 2007).

Cognitive Complexity

Learning is a complicated endeavor. The functioning of the brain and how we learn is only one aspect of what educators call “learning.” It is important for psychologists to understand the neural process of understanding and discover how each individual makes meaning of things, develops connections, evolves in thinking, develops epistemology, and reflects on individual judgment of learning. While there are many aspects of brain processes—social, psycho, motivation, neural, emotional, biological, and so on—this section focuses on the cognitive complexity of individuals. This section discusses the theories espoused by Piaget, Vygotsky, Perry, Belenky et al., Baxter Magolda, King and Kitchener, and Kegan, and how these theories relate to or differ from each other.

Cognitive Psychology

It is important to understand what cognitive psychology is so we can understand how these theories intersect and diverge. Each of the theories expressed in this section fall into the

realm of cognitive psychology. Cognitive psychology is a theoretical perspective that focuses on realms of human perception, thought, and memory (American Psychological Association, 2002). Cognitive psychology is different from other psychological approaches in two key ways: first, it accepts the use of the scientific method and generally rejects introspection as a valid method of investigation, and second, it explicitly acknowledges the existence of internal mental states, such as belief, desire and motivation, unlike behaviorist psychology (Broadbent, 1958). Each of the following five theories has these two things in common.

Jean Piaget

Piaget's contributions to cognitive development are immense; his ideas at times are highly complex and difficult to grasp. Piaget's theories are particularly prone to distortion, oversimplification, and general misunderstanding when the depth and breadth of his research is not fully realized. Piaget (1955) saw consistencies in children's behaviors across different areas at each point in development that led him to propose four stages of development: sensorimotor, preoperational, concrete-operational and formal-operational. The four stages involve moving from knowing the world through overt actions, to more or less static representations of it with symbols, to mental operations on present objects, to mental operations on operations. Later in his life, Piaget (1971) criticized his own model, saying it was too rigid and that children could actually develop faster earlier and generally developed slower later. His research led to others taking a closer look at the development process.

Robert Kegan

Kegan, a developmental psychologist at Harvard, is the author of numerous books, including *The Evolving Self* (1982). In this book he put forth his model on cognitive development and stressed the importance of context and environment in the evolution of thought in people. Kegan referred to this context as our embeddedness, and he not only refers to our external embeddedness in a culture but also of the internal embeddedness of each developmental stage in our psyches. Kegan presented a model of cognitive development consisting of six equilibrium stages: the incorporative stage, the impulsive stage, the imperial stage, the interpersonal stage, the institutional stage, and the inter-individual stage. The object of each stage is the subject of the preceding stage. The subjects of the incorporative stage (1) are reflexes, and it has no object (babies are in this stage). The subjects of the impulsive stage (2) are the individual's impulses

and perceptions, and its objects are the reflexes (toddlers are in this stage). The subjects of the imperial stage (3) are the individual's needs, interests, and desires, and its objects are the individual's impulses and perceptions (children). The subjects of the interpersonal stage (4) are interpersonal relationships and mutuality, and its objects are the individual's needs, interests, and desires (adolescents). The subjects of the institutional stage (5) are the individuals' authorship, identity, and ideology, and its objects are interpersonal relationships and mutuality (adults). The subject of the inter-individual stage (6) is the interdependability of self-systems, and its objects are the individual's authorship, identity, and ideology (i.e. Gandhi and Mother Teresa). Between each of these developmental levels is a thinking level (there are five). Being able to bridge the gap between the developmental levels determines your cognitive level. For example, if you can bridge the gap between the third and fourth developmental levels, you are a level 3 thinker. Since most people can relate to needs and desires and can understand the difference between that and relationships and mutuality, many adults are at the level 3 thinking ability. Being able to bridge the gaps between developmental stages 4, 5, and 6 is more complicated. Most graduate students can bridge the gap between developmental stages 4 and 5, making them a level 4 thinker. Only the most worldly ever ascend to level 5 thinking ability.

Lev Vygotsky

Vygotsky proposed the zone of proximal development as the process of building bridges between what people know and new information (Flavell et al., 2002). The movement from between what people know and new information is this zone. According to Vygotsky, it is the job of the teacher to guide a student through this zone to the new information. Understanding that people move through stages and that there is a role for the not only the student and the teacher, led to more studies on the development of the student.

Marcia Baxter Magolda

Baxter Magolda's model of epistemological reflection in *Knowing and Reasoning in College: Gender Related Patterns in Student's Intellectual Development* (1992) was developed from a 5-year study of students at Miami University. Using qualitative interviews, 101 students described their experiences with knowledge development from their first year in college through 1 year after graduation. Participants were predominantly white and were evenly split along gender lines. Based on the study, Baxter Magolda made several broad assumptions about

cognitive development. First, ways of knowing and patterns of knowing are socially constructed. Second, the best way to explore these patterns is through qualitative inquiry (gets to the essence on the meaning). Third, reasoning patterns are fluid and are constantly being created. Fourth, patterns are related to gender, but not dictated by gender. Fifth, the context of student stories is important. Finally, ways of knowing are presented as patterns rather than stages; the stories will vary based on experience. This study of epistemological reflection of college students led to even more studies on the subject.

Patricia King and Karen Kitchener

The reflective judgment model of King and Kitchener, as described in *Developing Reflective Judgment* (1994), asserted the development of reasoning from adolescence to adulthood. An extensive database containing both longitudinal and cross-sectional research was used in the development of the model. The reflective judgment model describes changes in epistemic assumptions and how these affect the development of critical or reflective thinking skills in young adults and adults, especially college students. The conceptual framework for reflective judgment is a stage model characterized by seven distinct but related sets of assumptions about the process of knowing and how it is acquired. The seven developmental stages of the reflective judgment model may be broadly summarized into three levels: pre-reflective (stages 1-3), quasi-reflective (stages 4 and 5), and reflective (stages 6 and 7) thinking. Pre-reflective reasoning is the belief that knowledge is gained through the word of an authority figure or through firsthand observation, rather than through the evaluation of evidence. Quasi-reflective reasoning (stages 4 and 5) is the recognition that knowledge contains elements of uncertainty, which may be attributed to missing information. Reflective reasoning (stages 6 and 7) is expressed in that knowledge cannot be made with certainty, but is not hindered by this either; rather, people in these stages make the best judgments that they can based on the best information that they have available. While this study focused on the development of reasoning, other studies observed other factors, such as gender.

Mary Field Belenky, Blythe McVicker Clinchy, Nancy Rule Goldberger, and Jill Mattuck Tarule

In *Woman's Ways of Knowing: The Development of Self, Voice, and Mind*, Belenky, Clinchy, Goldberger, and Tarule (Belenky et. al., 1997) presented a complex study of the

epistemological (how people come to acquire, process, value, and make or internalize knowledge) development of women, contrasting it with the patterns found in males at an elite university. The findings in the study went far beyond the university in their application. What they found was that women processed knowledge differently than men; woman's way of knowing expressed as voices. They categorized the voices into a hierarchy: (a) silence, (b) received knowledge (listening to the voices of others), (c) subjective knowledge (the inner voice and the quest for self), (d) procedural knowledge (the voice of reason, separate and connected knowing), (e) constructed knowledge (integrating the voices).

All of the aforementioned studies had one thing in common; they were developmental in nature. Knowing this, how do each of these theories relate to each other?

How They Relate to Each Other

Each of the aforementioned theories had the commonality of: (a) it accepts the use of the scientific method and generally rejects introspection as a valid method of investigation, unlike symbol-driven methods such as Freudian psychology, and (b) it explicitly acknowledges the existence of internal mental states, such as belief, desire and motivation, unlike behaviorist psychology. The theories also have other commonalities and differences. Belenky et al. and Baxter Magolda all studied college students. Piaget and Vygotsky studied children. King and Kitchener and Kegan developed theories that included adolescents through adulthood, while Kegan's theory also included pre-adolescents and more mature adults. Piaget, Baxter Magolda, and Kegan looked at the development of thinking skills, while Vygotsky, Belenky et al., and King and Kitchener analyzed how people "came to know;" epistemology. Belenky et al. and Baxter Magolda both identified gender as a covariate, and highlighted how gender affects learning as well as the differences between men and women. Vygotsky, Belenky et al., and Baxter Magolda all recognized that the social setting plays a large part in learning and development of knowledge. Most of the theorists identified levels that people would move to/through, except for Vygotsky and Baxter Magolda. Piaget and Baxter Magolda put forth that people developed in stages. Most people could move through these stages, just as someone would age and move through life experiences. Belenky et al., King and Kitchener, and Kegan theorized that not everyone would move to the highest levels of cognitive development. Another theorist that believed that not everyone moved through each of the stages of development was William Perry.

William Perry

In the 1960s and 70s William Perry developed a cognitive psychology model for intellectual development among college students. He postulated in *Forms of Intellectual and Ethical Development in the College Years: A Scheme* (1970, 1998), that students progress through four major stages: dualism or received knowledge, multiplicity or subjective knowledge, relativism or procedural knowledge, and commitment or constructed knowledge.

Students in the dualism stage believe there is a single right answer to all questions. Knowledge is perceived as truth delivered by professors. Dualistic thinkers resist thinking independently, drawing their own conclusions, stating their own points of view, and discussing ideas with peers; these are senseless tasks because they believe teachers should deliver the facts. They are especially uneasy when teachers disagree with each other. They believe that learning involves taking notes, memorizing facts, and later depositing facts on exams.

Students in the multiplicity stage, also known as subjective knowledge (Belenky et al., 1997), believe that knowledge is just an opinion and that students and faculty are equally entitled to believe in the value of their own opinions. They may disagree with faculty criticism of their work, attributing it to arrogance and the faculty's inability to recognize the value in alternative perspectives (Perry, 1970, 1981, 1998).

Students at the relativism stage, or procedural knowledge, recognize that opinions are based on values, experiences, and knowledge. All proposed solutions are supported by reasons. Some solutions are better than others, depending on context. The student's task is to learn to evaluate solutions.

Students at the commitment stage, or constructed knowledge (Belenky et al., 1997), integrate knowledge learned from others with personal experience and reflection. They can argue their perspective and consider the merit of alternative arguments by evaluating the quality of the evidence. Knowledge is constructed through experience and reflection. These students view faculty as having better-informed opinions in their areas of expertise and as being able to teach students techniques for evaluating the quality of evidence underlying conclusions (Perry, 1970, 1998). Some developmental theorists expanded on Perry's developmental scheme, such as William Moore.

William S. Moore's Expansion of Perry's Theory of Cognitive Development

According to William S. Moore, there has been increasing interest in assessment and instrumentation research on Perry's model (Baxter Magolda, 1992; Belenky et al., 1997; Moore, 1994). In Perry's original research, interviews were used to assess students' cognition. In the original studies by these researchers, an open-ended format of questioning was used. While interviews continue to be a rich and valuable means of assessing the Perry scheme, they are limited in their usefulness due to time constraints, complexity and costs involved in making transcriptions, and analyzing data. For that reason, Moore (1989) developed a quantitative method of evaluating student learning, the Learning Environments Preference or LEP.

In his (and this) research, the instrument used to evaluate cognitive development was the LEP. Moore stated that there seems to be a growing emphasis on thinking processes that are an outcome of the colligate experience. In his research he poses several questions: What is meant by thinking processes? How can they be taught? How can they be measured? (Moore, 1994).

The LEP is an objective, recognition-task instrument (Moore, 1989). This measurement was initially designed and validated based upon the qualitative research done on Perry's (1970, 1981, 1998) intellectual and ethical development model. According to Moore's (1989) preliminary longitudinal studies, there is a predicted upward trend in cognitive development from freshmen year to senior year. Moore found that there was a high correlation of scores on the LEP to the levels in Perry's scheme. The LEP addressed five domains, which included content, the role of the instructor, classroom atmosphere, and student evaluation. Each domain included statements that a student rated on a Likert-type scale. The student focused on the level of significance of each task in the learning environment. Moore stated that the Perry model reflected a great deal about student learning. He went on to say that "education is transformational for the learner and not just an experience where the learner is memorizing new material" (Moore, 1989, p. 511). Moore also believed that educational processes help to develop thinking abilities so that students are able to think about things in greater depth. Therefore, Moore believed that Perry's scheme could be used to assess the students' level of development. Moore portended that the Perry scheme helps to inform learning and teaching because it shows the level of thinking development in the students.

Moore put forth that while he suggests that the Perry schema may be a good tool for evaluating a students' thinking ability, teachers are not taught how to create the type of learning

environments that facilitate the development of complex thinking (Moore, 1994). Moore cited work by several other people, to include Baxter Magolda (1992) and King, Kitchener, Davison, Parker, and Wood (1983), to support his hypothesis. How do teachers create these learning environments? Moore presented several methods for developing thinking abilities, including developmental instruction (Moore, 1994) and the notion of learning environments (Moore, 1989). In addition to developing thinking abilities, he also stated that teachers should place emphasis on ethical development, just as Perry (1970, 1981, 1998) mentioned in his own research.

Moore explained in his research that learning should not be just about academics, but should also be about the development of the students' self-identity and life (Moore, 1989). Students' lives and experiences are all brought into the classroom and should be considered when applied to the acquisition of knowledge. Students are not disembodied minds in the classroom, and treating them as such would inhibit the development of epistemologies, and thus, better thinking.

Moore also believed that learning should be transformational. He stated that the learning process should develop qualitative changes in the students (1989). Students are not always self-aware that these changes are occurring, but they are nonetheless happening. Learning should not only serve the purpose to inform, but also should help students to understand that the world is a complex place and that there is a lot of ambiguity that cannot be known. Learning is a process not only of acquiring knowledge, but of growth and understanding about ones' self.

Learning is about the development of the person, the acquiring of information and the growth of thinking skills, but it is also about loss (Moore, 1989). With the development of thinking skills comes the price of a new way to view the world. With the development of thinking there is an expectation that each situation will make sense, and that every experience that doesn't make sense opens up a whole new infinity of knowing (Moore, 1989; Perry, 1970). It is this loss of naïveté that Moore described. No longer can a student turn a blind eye to the unknown, but the student must be challenged by it.

Throughout the four periods of the Perry scheme, trends recur in developmental models: from concrete and simplistic to abstract and complex thought processes, from absolute to relativistic belief systems, and from external to internal control, as the student increasingly reflects upon and takes responsibility for actions, choices, and the selection and formulation of a

world view. As Moore stated in his research, using the Perry scheme as a central assessment framework represents and reinforces the perspective that assessment activities related to learning must emphasize both proving the effectiveness of learning and improving the quality of teaching and learning in the classroom. Cognitive complexity as reflected by the Perry scheme assists in consideration of the goals of higher education. Perhaps most importantly, according to Moore (1989), is the understanding that the perspectives reflected in the Perry model help us to understand students better.

The Military, Creativity and Cognition

Creativity, cognitive development and critical thinking are buzzwords throughout the Army. Several factors combined to force the Army to think about the way it develops and nurtures its leaders. The Army Special Warfare Center at Ft. Bragg, NC, as well as the Joint Special Operations University at U.S. Special Operations Command at McDill Air Force Base in Tampa, FL (the proponent for Special Operations education), determined that special operations field grade officers (majors and lieutenant colonels, see Appendix G) needed to be adaptive, creative, and think at a high level of cognitive complexity (Brown, 2006). These qualities allow special operations field grade officers to solve complex problems better and thrive in the uncertain environment in which special operations forces operate. There are many components of training, educating, and evaluating special operations majors for creativity, adaptability, and critical thinking. How do we identify these qualities? How to we train and educate these competencies? How do we measure whether learning is taking place? Exploring army efforts on education for adaptability, creativity and critical thinking and how we evaluate soldiers on these competencies is the topic of this section.

In 2000 the Army Research institute commissioned a study on decision making skills in the training and education of army majors (Cohen et al., 2000). The research had three primary objectives. First, the study developed and extended a theory of the cognitive skills that an individual needs to function effectively in fast-paced and uncertain domains. Second, it developed methods to train those skills in the context of Army battlefield decision making paradigm and to improve the ability of Army tactical staff officers to grasp the essential elements of a complex, uncertain, and dynamic situation, visualize those elements in terms of their organization's goals, and take action in a timely and decisive manner. Third, it developed

architecture to support adaptive instruction and feedback in critical thinking training. The architecture should be able to simulate both rapid responses to familiar situations and more reflective responses to novel and uncertain situations. The project introduced innovative statistical methods for discovering the cognitive structure and thinking strategies utilized by decision makers and applied these methods to analyze several dozen interviews with active-duty Army officers.

Again in 2000, a study was conducted on the situational awareness and decision making abilities of pilots under stress. Because pilots must maintain a high level of situational awareness and must use critical thinking skills to evaluate situations, problems with situational awareness were found to be a major cause of aviation accidents (Endsley & Robertson, 2000). Due to the important role that situational awareness and critical thinking plays in the decision making process of the pilot, it was found that a system was needed to evaluate pilots for both of the aforementioned capabilities.

In December 2005, Don Vandergriff and Jeff Roper studied what training and education should take place to foster adaptive leadership in the army. They asserted that decision-making is central to the United States Army leader. They believed that the essence of effective leadership is to make and communicate sound decisions. They also believed it is essential for the Army to produce leaders that can make effective decisions in a timely manner by using a naturalistic decision making process, such as recognition primed decision-making (RPD) (Klein, 2001) instead of the analytical method of the Military Decision-Making Process (MDMP). They reasoned that the MDMP represents the old leader paradigm of task-centric proficiency. They asserted that future leaders need to learn to use RPD to make decisions. However, this type of decision-making requires a substantial investment in time for the decision-maker to accumulate an adequate base of knowledge to utilize.

Related to the aforementioned study on judgment and decision making, Vincent Chan and Neil Schmitt examined how civilian employees' situational judgment affected job performance (2002). Civil service employees ($n = 160$) demonstrated the validity of a situational judgment test in predicting overall job performance, as well as three performance dimensions: task performance (core technical proficiency), motivational contextual performance (job dedication), and interpersonal contextual performance (interpersonal facilitation) (Chan and Schmitt, 2002). Chan's research was significant because many of the things that he evaluated in

civil employees were similar to what the military does to evaluate job performance of special operations forces.

According to research conducted by the Army Research Institute (ARI) in 2004 and 2005, the need for adaptable leaders in the military is increasingly apparent in the post 9/11 environment and the subsequent Global War on Terrorism (Mueller-Hanson, White, Dorsey & Pulakos, 2005). The research indicated that relatively little is known conclusively about whether adaptability can be learned or about the best means to learn it their research and practical applications began to shed some light on these issues. Their research described the important elements of the training and development of officers that can enhance their adaptive performance. The first step was to define and describe adaptability and the adaptability-related behaviors that are important for military leaders. Next, the knowledge, skills, and abilities that are needed to successfully perform in an adaptable fashion were identified. As not all of these characteristics were amenable to training, they discussed which characteristics were most appropriate to target in a training program and which might be more appropriate as selection factors. Finally, they integrated research on adaptability behaviors, characteristics related to adaptability, and effective training interventions to present concrete recommendations for developing adaptable leaders via the three pillars of Army training: institutional, operational, and self-development.

Based on existing research, ARI defined adaptability as an effective change in response to an altered situation. This definition emphasized that an individual must recognize the need to change based on some current or future perceived alteration in the environment and change his or her behavior as appropriate. The ARI research demonstrated that within this broad definition, adaptability is a multifaceted construct with several distinct dimensions (Mueller-Hanson et al., 2005). For this report, these dimensions were grouped into three overarching types of adaptability, each of which is potentially important in developing military leaders: mental, interpersonal, and physical adaptability. In addition to these important individual performance dimensions, leaders have the added task of developing adaptability in their units by encouraging and rewarding adaptive behavior and by ensuring that everyone works together in a coordinated fashion. A number of personal characteristics were related to successful adaptive performance, including personality traits, cognitive skills, interpersonal skills, and the extent of one's domain-specific knowledge and experience (Mueller-Hanson et al., 2005).

This research suggested that two training principles are particularly important with respect to training adaptive performance. First, that training interventions should incorporate as many opportunities as possible for emerging leaders to be exposed to situations requiring adaptability. Whether simulated or real, this exposure allows the individual to begin to build his or her own catalog of experiences from which to draw on in the future, thereby speeding up the acquisition of expertise. Second, an iterative process of practice, feedback, and practice are a necessary part of development. Individuals should have the opportunity to practice new skills, obtain feedback on their results, and apply what they learned from this feedback in subsequent practice sessions. In an adaptability context, individuals should have ample opportunities to practice their adaptability related skills in a variety of settings and obtain feedback from a variety of sources (Mueller-Hanson et al., 2005).

Finally, the research on adaptability was integrated with the research on effective training principles to propose recommendations for the development of adaptive leaders via institutional, operational, and self-development methods. The first step in designing this training adaptability is to identify whether specific jobs require adaptive performance, keeping in mind that some jobs do not require adaptability. Once adaptable performance is defined for a given job, the information in this report provided concrete ideas that could be applied to enhance the development of adaptive performance, whether it is in a program of instruction, in the field, or as part of a self-development program. According to ARI, developing adaptive performance in Army leaders will likely require a substantial investment in an integrated training system from the beginning of an officer's career until the end. Junior level leaders should be exposed to adaptability training at the start of their careers through classroom and field exercises, during the early part of their careers through operational experiences and feedback mechanisms, and continuing throughout their careers through ongoing professional development (Mueller-Hanson et al., 2005).

In another Army Research Institute study, research was conducted to develop 3½ day training program to develop adaptive thinking and leadership in Special Forces captains (White et al., 2005). The U.S. Army John F. Kennedy Special Warfare Center and School at Ft Bragg, NC, (USAJFKSWCS) and the ARI identified the need to enhance the adaptive skills of Special Forces officers. Adaptive proficiency is critical for operating in the dynamic special operations environment, and increases in mission tempo required that officers be proficient and

operationally prepared immediately upon entering Special Forces. This required that the Special Forces Qualification Course (SFQC) be modified to provide more direct training in the area of adaptive performance. USAJFKSWCS provided funds to ARI to develop a 3½-day introductory course on adaptability, specifically tailored to the special operations environment. The course was developed with the intent of better preparing officers for the adaptability requirements they face during later phases of the SFQC, as well as in the field as Special Forces officers.

The framework of the adaptability course was carefully constructed from current knowledge and literature regarding the topic of adaptability. Specific lecture materials and exercise content was then tailored specifically to special operations forces by reviewing written materials about special operations, observing special operations field exercises, and conducting surveys, interviews, and focus groups with ARI and personnel at the JFKSWCS Directorate of Training and Doctrine. The adaptability course was developed to be held during Phase III of the SFQC, and was called the Officer Adaptive Thinking and Leadership course (O-ATL). The course introduces the students to the meaning of adaptability in the special operations environment, covering the myriad of ways in which special operations officers are required to adapt. In particular, the course focuses on the topics of mental adaptability, interpersonal adaptability, and leading an adaptable team. The course provides the students with an understanding of each topic's relevance to their job, as well as tools and strategies for better navigating situations that require different types of adaptability. Case studies and scenario-based exercises are used throughout the course to provide students with learning experiences from which they can draw in the future. The O-ATL course was initially pilot tested with a group of SFQC officer candidates in April 2003. Subsequently, the course was refined and pilot tested again in January 2004. Final revisions were made to the course based on the results of the second pilot test, and final course materials were delivered in February 2004. The course was permanently integrated into the SFQC. While the materials described in the ARI report were developed specifically for officers in training for Special Forces, the concepts and approach described were also applied to other training programs at USAJFKSWCS. New efforts at USAJFKSWCS were made to apply the concepts and materials developed for officers to Special Forces Warrant Officers, non-commissioned officers, and Civil Affairs and Psychological Operations officers. According to ARI, the training principles and processes could be readily applied to numerous other personnel and units across the Army (White et al., 2005).

The Army War College publishes articles written by the War College attendees in their publication, *Parameters*. Senior leadership in the army identified that one of the reasons that junior officers were not developing good problem solving habits was because of a lack of mentorship from senior officers. In the *Parameters* article, “The Road to Mentoring: Paved With Good Intentions,” the purpose was to help inform the developing dialog by assessing the current treatment of the mentoring concept in today’s Army and then highlighting the issues, implications, and alternatives relative to a formal Army Mentorship Program (Martin, Reed & Collins, 2002). The article asserted a belief that unless the concept and implications of a program are carefully reevaluated, this potentially useful leadership concept may remain a confusing cliché or euphemism for favoritism, causing it to undermine the desired leadership environment. The article goes on to state that one of the major components of the mentorship program is the development of the junior officer’s tendency to be more adaptive, creative, and critical as a thinker. In an earlier study, researchers attempted to quantify cognitive development through testing.

Cognitive Task Analysis (CTA) is a set of methods for identifying the cognitive skills, or mental demands, needed to perform a task proficiently (Militello, 1998). In a 1998 article of *Ergonomics* magazine, the authors produced a task analysis that can be used to help develop the design of training systems. However, CTA is resource intensive and has previously been of limited use to design practitioners, according to the article. A streamlined method of CTA, Applied Cognitive Task Analysis (ACTA), was presented in the article. The ACTA system consists of three interview methods that help the practitioner to extract information about the cognitive demands and skills required for a task. ACTA also allows the practitioner to present this information in a format that will translate more directly into application, such as improved training scenarios, according to the authors. Their paper described the three methods, an evaluation study conducted to assess the usability and usefulness of the methods, and directions for future research for making cognitive task analysis accessible to practitioners. ACTA techniques were purported to be easy to use and flexible and to provide clear outputs. Follow on researchers attempted to analyze these processes under stress.

A 7-year research project called TADMUS (Tactical Decision Making Under Stress) was elaborated in the book, *Making Decisions Under Stress: Implications for Individual and Team Training* (Cannon-Bowers, 2000). The goal of the study, sponsored by the Office of Naval

Research, was to develop training, simulation, decision support, and display principles that would help to mitigate the impact of stress on decision making. The book outlined the overall background, research approach, and paradigm employed by TADMUS, with specific focus on research regarding how to train decision making at the individual and team levels, especially how to provide training that will prepare individuals to operate in complex team environments. Throughout the book, the authors explored the research implications and the lessons learned that may guide those interested in applying results of the research in operational environments, such as the training and education of the Navy's special operations officers. Other researchers took a different approach and viewed the way that the military stifles creativity through its institutions.

In an article for *Military Review*, Joellen Killion (2000) asserted that the military decision making process (MDMP) should be reviewed because of its creativity-stifling methods. He suggested that the army should employ the recognition-primed decision making model proposed by Robert Kline. He proposed that officers should go through more practical exercises so they have more experience on which to base their decisions; this would facilitate greater creativity in their problem solving. Killion maintained that the operational planning method of J.O.P.E.S (Joint Operational Planning and Execution System) limits a planner's creativity and myriad of plausible solutions based on the process followed by the planner using the system. He asserted that the military should adopt a more flexible system of operational planning that allows creativity and new solutions to problems, especially the type that planners may encounter in the contemporary operating environment.

Another report done of Army Special Forces soldiers was done by the Human Resources Research Organization in 1996. This report described a job analysis of U.S. Army Special Forces jobs (Russell, Crafts, Tagliareni, McCloy, & Barkley, 1996). The overall goal of the research was to gather information that would aid in the development of new Special Forces performance measures. This goal required two types of information to be collected: the individual attributes requisite to Special Forces performance and the field performance of jobs. The research involved five major steps: (a) development of workshop materials and logistics, (b) administration of workshops to collect critical incidents and task and attribute ratings, (c) analysis of task and attribute data, (d) development of performance categories and behavior-based rating scales, and (e) analysis of linkages between attributes and performance categories. Active duty Special Forces officers and a subject matter expert panel composed of Special Forces officers and non-

commissioned officers (NCOs) at the USAJFKSWCS participated in all parts of the research project. The primary products of the project were behavior-based rating scales for Special Forces jobs, definitions of individual attributes important for successful performance in their jobs, and job task ratings.

A study by the ARI in conjunction with the Army Command and General Staff College recognized the importance of creativity, adaptability, cognitive development and critical thinking training in the intermediate level education for Special Operations Force officers (Clark et al., 2006). The USAJFKSWCS recognized that adaptive performance is critical to the effectiveness of Special Forces officers as they operate in the ambiguous and changing environment of asymmetric warfare. Given that adaptability is a requirement for all Special Operations Forces soldiers, it is important to identify adaptive training and education requirements for all levels of leadership. In addition, there is a need to determine whether current officer development programs can be enhanced or modified to better prepare Special Operations Force officers for their future responsibilities.

The Directorate of Training and Doctrine (DOTD) at USAJFKSWCS contracted with the ARI, to identify adaptive education requirements for U.S. Army Special Forces, civil affairs, and psychological operations majors attending the Command and General Staff College (CGSC) for intermediate level education (ILE). They were also asked to make recommendations regarding how the current curriculum could be enhanced or modified to focus on building adaptive skills appropriate for the Special Operations Force students attending CGSC. The primary objective of the work described in their report was to provide a detailed description of the process undertaken by the researchers to determine the adaptability educational requirements for the ILE Special Operations Force curriculum at CGSC (Clark et al., 2006). The report also provided the results and recommendations for enhancing adaptability education in the current curriculum.

The researchers conducted a needs assessment to determine the core responsibilities of Special Operations Force majors, the adaptability requirements associated with those core responsibilities, and how adaptability was currently addressed in the core curriculum. They conducted a number of focus groups with recent graduates (within the last 5 years) from the ILE to gather information related to their job responsibilities and the adaptive requirements of their jobs, as well as to obtain recommendations on how to improve the adaptive education at ILE. The final phase focused on reviewing the current ILE curriculum by interviewing instructors and

students to determine the degree to which adaptability was addressed in the curriculum. In addition, they obtained recommendations from students, instructors, and guest lecturers on how adaptability skills could be further developed (Clark et al., 2006).

The analyses of the data and information collected shows that adaptability is a core component of the tasks demanded of majors in staff positions. Specifically, interpersonal adaptability and several aspects of mental adaptability, such as creative problem solving, dealing with uncertain or ambiguous work environments, and coping with stress, are critical skills to improve. In addition, they found that although some of the material covered throughout the curriculum related to adaptability (i.e. the critical thinking, cognitive development and creativity course) there was further need for more advanced and applied lessons and exercises pertaining to adaptability and its components (Clark et al., 2006).

The adaptability components they proposed would leverage the prior training Special Operations Force officers received during the various qualification courses and maximize the strengths of the CGSC learning model. The authors proposed to place adaptability lessons throughout the various parts of the Special Operations Force curriculum under 4 main organizing structures: introduction to adaptability, mental adaptability, interpersonal adaptability, and building and operating in adaptive systems (Clark et al., 2006). While studies like Clark's were in progress, the military continued to evaluate itself through introspection.

Don Vandergriff wrote a compelling white paper addressing the need to evaluate the Army training programs for adaptability (2005). His paper examined Army adaptability training and its implications on the Army's leader development paradigm, as well as the concepts of institutional adaptability; specifically, how the Army can move beyond technologies and ideas to entail a new cultural mindset that supports adaptability, not only in its leaders but also in its institutions. The author then advanced a recommended model to develop adaptability while defining adaptability.

After years of studying and reading, Army officers typically develop a comprehensive understanding of the elements of tactical decision-making. However, that knowledge alone, no matter how extensive, is not sufficient to produce good adaptive thinking, cognitive development, and creativity. In an *Army Research Newsletter* from 2000, Marvin Shadrick asserted that the army was not producing officers that are adaptive, complex, and creative in their thinking. He stated that thinking is an active process; it is a behavior one does with his or her

knowledge; it is not the knowledge itself. He stated that in order to produce good military adaptive, complex, and creative thinkers, the Army must train a performance in much the same way that any skilled, well-rehearsed, and extensively practiced behavior is trained to enable expert performance.

Shadrick (2000) declared that in military terms, adaptive, complex, and creative thinking is used to describe the cognitive behavior of an officer who is confronted by unanticipated circumstances during the execution of a planned military operation. The conditions in which the thinking task must take place are an essential and defining ingredient. The thinking that underlies battlefield decisions does not occur in isolation or in a calm reflective environment; it occurs in a highly challenging environment. Commanders must think while performing: assessing the situation, scanning for new information, dealing with individuals under stress, and monitoring progress of multiple activities of a complex plan. Other researchers tried to see if there was a way to quantify adaptability and creativity.

In 2000 Elaine Pulakos, Sharon Arad, Michelle Donovan, and Kevin Plamondon wrote a research paper on the taxonomy of adaptive, complex, and creative job performance in the workplace. The purpose of their research was to develop a taxonomy of adaptive job performance and examine the implications of this taxonomy for understanding, predicting, and training adaptive, complex, and creative behavior in work settings, outside of a military setting. Two studies were conducted to address this issue. In the first study, over 1,000 critical incidents from 21 different jobs were content-analyzed to identify an 8-dimensional taxonomy of adaptive performance. The second study reported the development and administration of an instrument, the Job Adaptability Inventory, which was used to examine empirically the proposed taxonomy in 24 different jobs. Exploratory factor analyses using data from 1,619 respondents supported the proposed 8-dimension taxonomy from the first study. This information could be used and correlated to evaluating job performances in the military, as well. Other researchers attempted to quantify creativity and adaptability as well.

Steve Kozlowski and Rebecca Toney (2001) asserted that it is possible to predict, with certainty, how a trainee will respond to adaptability and creativity training. They developed a theoretical model called Adaptive Learning System (ALS). This model would predict behavior characteristics in trainees on adaptability, cognitive development and creativity.

Although much has been written on human performance, it seems that the most substantial amount of research in the areas of creativity, adaptability, and critical thinking have been done by the ARI. Their research in the past 6 years on Special Forces officers links directly with evaluating the same traits in Special Operations Force soldiers and officers in general.

A Connection between Cognition and a Psychometric Approach to Creativity

Psychology has several areas of research into creativity. Robert Sternberg and Todd Lubart in the *Handbook of Creativity* in 1999 divided these areas into (a) mystical approaches such as Plato and Jung; (b) pragmatic approaches such as Edward DeBono, Alex Osborn, and Roger VonOech; (c) psychometric approaches such as Guilford and Torrance; (d) cognitive approaches like Howard Gardner; (e) social approaches like Teresa Amabile; and (f) confluence approaches like Sternberg and Mihaly Csikszentmihalyi. This research focused on the convergence of the cognitive approach and the psychometric approach.

Psychometric Approach and Torrance

Before Ellis Paul Torrance took up his study of creativity, others preceded him such as J. P. Guilford (President of the American Psychology Association), Mary Meeker (one of Guilford's students who carried on his work), Jacob Getzels and Phillip Jackson, and Michael Wallach and Nathan Kogan (who all researched divergent and convergent thinking), and James Kaufman and John Baer (who studied domains of creativity) (Guilford, 1950; Meeker, 1969; Piirto, 2004). Torrance took a different approach to studying creativity.

Torrance always believed that in addition to the traditional IQ tests, creativity should be used to determine gifted and talented children in school. After teaching in middle school and high school special education classes for children that other teachers labeled as un-teachable, Torrance was able to capitalize on the students' creativity and outscore the more traditional students on standardized tests (Torrance, 1979, 2002). It was during this time, prior to World War II, that Torrance realized that there was a connection between creativity and thinking ability. During World War II and the Korean War Torrance worked for the Army, and later the Air Force, to help identify soldiers and airmen who had unique abilities to generate creative solutions to problems in survival situations (2002).

After his service, Torrance began work in 1958 at the University of Minnesota. He conducted longitudinal studies of children in Minnesota schools (Torrance, 1974a, 1974b).

Torrance developed a variety of tests for creative thinking ability. His first major predictive study was on elementary education majors, who were followed up 8 years later. These elementary school teachers were then given a battery of tests that showed coefficients of correlation of $r = .62$ and $r = .57$, that were obtained between the indices of creative teaching behavior and two measures of verbal creativity that were obtained at the time they were juniors in college (1979). At the same time that Torrance was doing the aforementioned study, he began a longitudinal study of grade school and high school students. Torrance compared the students' scores on his creativity tests with real-life creative achievements (1972). An overall validity coefficient of $r = .51$ was obtained for the creativity measures.

By the 1970s his *Torrance Tests of Creative Thinking* (TTCT) began to be widely used in schools (Torrance, 1979, 2002). These tested fluency (the total number of interpretable, meaningful, and relevant ideas generated in response to the stimulus), flexibility (the number of different categories of relevant responses), originality (the statistical rarity of the responses among the test subjects), and elaboration (the amount of detail in the responses). The higher the score, the more potentially creative the child was. There has been debate in the psychological literature about whether intelligence and creativity are part of the same process (the conjoint hypothesis) or represent distinct mental processes (the disjoint hypothesis). Evidence from other attempts to examine correlations between intelligence and creativity from the 1950s onwards, by Guilford or Wallach and Kogan, suggested that correlations between these concepts were low enough to justify treating them as distinct concepts (Guilford, 1950; Meeker, 1969; Piirto, 2004). Other researchers believed that creativity is the outcome of the same cognitive processes as intelligence, and is only judged as creativity in terms of its consequences (Csikszentmihalyi, 1996). A popular model is what has come to be known as “the threshold hypothesis,” proposed by Torrance, which states that a high degree of intelligence appears to be a necessary but not sufficient condition for high creativity (Torrance, 1979, p.7). This means that, in a general sample, there will be a positive correlation between creativity and intelligence, but this correlation will not be found if a sample of only the most highly intelligent people is assessed (Torrance, 1979).

In 2001, Garnet Millar published a book of case studies. These studies followed up on the students studied by Torrance in 1958; those who had creative accomplishments were called “beyonders” by Torrance (1991, p. 69). Subsequent studies of the students in the Torrance

project yielded results similar to those of Torrance (Baldwin & Wooster, 1977). In 2002, Torrance published *The Manifesto*, a summary of his life's work; the implications of creativity for career planning (Torrance, 2002). In this he stressed that capitalizing on an individual's creativity is important in life's pursuits, and to be happy.

Cognitive Psychology and the Connection to Creativity

The cognitive psychologist seeks to determine what happens in the mind while the person is creating. A definition of creativity is an insight, intuition, a process of selection, and the ability to adapt to novelty (Csikszentmihalyi, 1996). In their 1976 ground-breaking study of problem finding in visual artists, Jacob Getzels and Mihaly Csikszentmihalyi thought that creativity was an attempt to reduce tension that may or may not be perceived consciously. Artists did this through imagination. When artists work, the conflict that the artists feel is changed within their *self* into a problem. The artist finds the problem that will lead to the work of art. This happens over and over again as the artists work.

“Creative cognition” is a term used by cognitive psychologists, such as Thomas Ward, the editor of the *Journal of Creative Behavior*. These researchers seek to use psychological research methods in order to study the underlying cognitive means by which people produce creative thought. They affirm the *generativity* of the human mind and assume that the capacity for creative thought is within all of us (Finke et al., 1996). Although these researchers acknowledged the importance of factors such as intrinsic motivation and internal values, they concentrated on the cognitive because many of the non-cognitive factors manifest themselves through the cognitive.

Cognitive psychologists have conducted controlled experiments on people's exploratory processes, pre-inventive structures, insight, extending concepts, and conceptual combination (Finke et al., 1996; Flavell et al., 2002; Plucker & Beghetto, 2006). These researchers believed that studying creative cognition could resolve the quintessential conflicts about the complex construct of creativity, such as whether creativity is goal-oriented or exploratory. In 2001, Ward used a case study approach to illustrate these points in his explication of the writing process of fantasy writer Stephan Donaldson. Other researchers tried to identify other parts of cognition, such as intelligence(s).

Howard Gardner, in *Frames of Mind*, said that there are seven different intelligences: linguistic, musical, logical-mathematical, spatial, bodily-kinesthetic, interpersonal, and intrapersonal intelligence (1983). In late 1996, Gardner, Mindy Kornhaber, and Warren Wake added another intelligence, that of the naturalist (like James Audubon or Charles Darwin). In Gardner's theory, creativity is an aspect of each of these intelligences as they are perfected and developed, and not a separate intelligence or ability. Gardner asserted that creativity cannot take place without the odd interaction, or asynchrony of place, time, talent, and mortality. There is tautness or strain "between intellectual and personality styles, and by a striking lack of fit between personality domain, intelligence and field, and biological constitution and choice of career" (Gardner, 1983, p. 64). He said that this pressure may be the impetus that causes a person to go off and make something new and creative.

Gardner explored these intelligences domain by domain. He published case studies of geniuses in each of the seven intelligences under the title *Creating Minds* (1993). Every one of his books has the word "mind" in the title to emphasize that he is speaking about the cognitive, that he is interested in what happens in the brain. His theories had great impact on public and private schools in the mid-1990s as teachers began to teach using the multiple intelligences. Gardner's (1993) definition of creativity is that a creative person solves problems, fashions products, or poses new questions within a domain in a way that is initially considered to be unusual but is eventually accepted within at least one cultural group. Gardner's complex theory of the development of creative individuals takes into account three relationships: (a) between the creative child and the adult he or she becomes, (b) between the creative person and others, and (c) between the creative person and the work he or she does. Gardner also noticed that in each of the case studies, there was a strained interaction between the creative individual and the world around them. Other researchers defined intelligence differently.

Robert Sternberg in *The Triarchic Mind* (1988), named three types of intelligence: the creative, the analytic and the practical. The creative includes the ability to adapt to what is novel or the ability to make something new. He called his theory "triarchic," insisting that each intelligent act incorporates creativity in insight, planning, research, and finally doing the act. Like many contemporary psychologists and educators, Sternberg suggested that having a high IQ is not the primary requirement for a successful life, but that other components are necessary. Again, the evolving idea is that creativity is necessary for the development of talent. Sternberg

focused on the everyday creativity that is exhibited when a person leads an intelligent life. The six facets of creativity are (a) having creative intelligence, (b) having specific knowledge within the domain, (c) having a certain style of mind, (d) having certain aspects of personality, (e) having motivation, and (f) having a nurturing environment.

By 1995, Sternberg and his colleague Todd Lubart had published several variations on a theory of creativity called investment theory (Sternberg & Lubart, 1996). Using the metaphor of the stock market, they stated (p. 678) that the truly creative risk taker invests by trying to buy low and sell high—that is, “creatively insightful people need to invest themselves in their projects to yield the value added to the initial idea.” By 2001, Sternberg, James Kaufman, and Jean Pretz had revised the investment theory to include a propulsion theory; they delineated eight different types of creative contributions that are possible within any given field of a domain. Four of these accept the current paradigms and attempt to extend them: (a) replication, (b) redefinition, (c) forward incrementation, and (d) advance forward incrementation (Sternberg et al., 2002). Three kinds of creative contribution reject current paradigms and attempt to replace them: (e) redirection, (f) reconstruction/redirection, and (g) reinitiation. The eighth kind of creativity is one that synthesizes the paradigms, (h) integration.

Testing for Creativity: Two Camps

There are essential two schools of thought on the value of testing for creativity. The aspects of divergent thought production were defined by Guilford (1950), which are fluency, flexibility, elaboration, and so on. Many believe that there is much evidence to support this continued testing. Amabile (1987) suggested that assessing with tests such as the TTCT is valid, reliable, and comprehensive. Other cognitive psychologists suggested that creativity testing has little value. Sternberg said that such tests only capture the most trivial aspects of creativity (1988). Gardner concurred that the measures that are used in creativity tests are essentially trivial and can be “surmounted in a matter of minutes” (1982, p. 13).

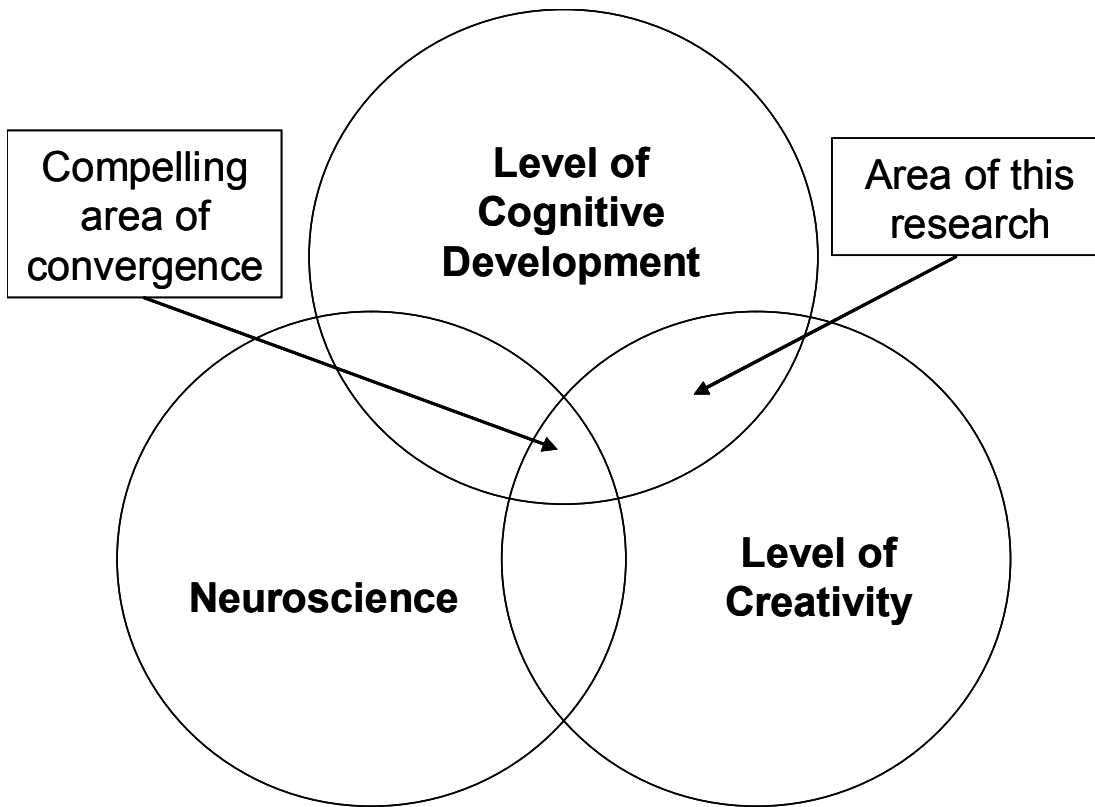
So, it appears that there are two major groups of theorists. One group has spent 40-50 years trying to develop tests that have validity and reliability. Another group insists that creativity is a process that is explainable by noticing how creative people think (Piiro, 2004). Regardless, there seems to be no slowing down in the testing of children for creativity. The state of Kansas requires a form of the TTCT-Figural to be administered to children being tested for the

gifted and talented program in order to determine academic potential for admission into the program (M. Gladhart, personal communication, 2006).

Neuroscience: The Bridge between Cognitive Psychology and Creativity?

Neuroscience is a burgeoning area within the field of creativity; in fact, the entire area of neuroscience is cutting edge. Theorists from this perspective postulate that creative innovation might require co-activation and communication between regions of the brain that ordinarily are not strongly connected (Figure 2.3). Highly creative people who excel at creative innovation tend to differ from others in three ways: they have a high level of specialized knowledge, they are capable of divergent thinking driven by frontal lobe activity, and they are able to regulate neurotransmitters such as norepinephrine in their frontal lobe (Andreasen, 2006). According to Andreasen, the frontal lobe appears to be the part of the prefrontal cortex that is most important for creativity; for that matter, the prefrontal cortex is responsible for all executive function, including logic and reason.

Figure 2.3 The Convergence of Cognitive Development, Creativity and Neuroscience



In 2005, Alice Flaherty presented a model of the creativity that had three factors. Drawing from evidence in brain imaging, she described the creative phenomena as resulting from an interaction of the frontal lobes, the temporal lobes, and dopamine. The frontal lobes can be seen as responsible for idea editing and evaluation (criticality, logic, etc. so there is a biological connection between creativity and cognitive ability level), and the temporal lobes for idea generation (creativity). She found that abnormalities in the frontal lobe generally decrease creativity, while abnormalities in the temporal lobe often increase creativity, sometimes to a not-so-useful level. She also found that high activity in the temporal lobe typically inhibits activity in the frontal lobe, and vice versa. She discovered that high dopamine levels increase general arousal and goal-directed behaviors and reduce inhibition, and all three effects increase the level of new idea generation.

Larry Vandervert described how the brain's frontal lobes and the cognitive functions of the cerebellum collaborate to produce creativity (Vandervert, 2003a, 2003b; Vandervert et al.,

2007). Vandervert's explanation relied on evidence that all processes of working memory are routed through the cerebellum and inner brain. The cerebellum, consisting of about 60-100 billion neurons, is also widely known to model all bodily movement adaptively, as well as involuntary, non-thinking functions. Apparently, creative insight, or the ah-ha experience, is triggered in the temporal lobe. Since the cerebellum adaptively controls all movement and all levels of thought, and transmits stimulus responses to areas of the brain that govern emotion (hippocampus, amygdala), therefore Vandervert's theory helps explain creativity and innovation in sports, art, music, mathematics, and thought in general.

Understanding neuroscience is most certainly important to this research. For example, in examining how thoughts are routed through parts of the brain, it is clear that non-thinking parts of the brain (cerebellum) evaluate the stimulus. This stimulus is then sent to emotional regulators (hippocampus, amygdala) in order to screen for a fight or flight response. The stimulus is then sent forward to the prefrontal cortex and to the frontal lobes for evaluation of logic and reason. Next, thoughts are sent to medial and lateral lobes for humor and creativity responses (Vandervert, 2003a, 2003b; Vandervert et al., 2007). The prefrontal cortex regulators sense patterns and schema, and draw on memories to make connections to past experiences. From this, it is possible to make a connection between the activity in the frontal lobes (logic and reason) and the medial and lateral lobes (creativity) and deduce that there is an association between cognitive levels and creativity.

Summary

This chapter discussed the field of creativity and cognitive complexity and how they relate to each other. A history of the study of creativity was presented. An overview of the major perspectives in the field of creativity was discussed, in addition to major theorists in each one of the major perspectives. Cognitive complexity and cognitive psychology were discussed. Research was presented on how the military has studied creativity and cognition. The chapter concluded with research that made a connection between cognitive complexity, neuroscience, and creativity.

CHAPTER 3 - Methodology

Introduction

This chapter describes the methodology used in this study. It begins with identification of the research questions, followed by a description of the research design employed and rationale for its selection, including a description of the study, population, and sample, and the analysis and recording of the data. The research design is described in detail and addresses the survey instruments, validity and reliability of survey instruments, and data collection and analysis procedures.

The enemy that faced the military in 2007 was at times ambiguous and asymmetric. The Department of Defense asked its leaders to think in complex ways and to be creative (Miles, 2008; *Command and General Staff College campaign plan*, 2005; *National Defense Strategy*, 2005; *National Military Strategy*, 2004). The objective of this research was to explore the nature of the relationship between being able to think in cognitively complex ways and being able to think creatively.

The purpose of this study was to investigate whether a relationship exists between cognitive development levels and the level of creativity in field grade officers at the Joint and Combined Warfighting School in Norfolk, VA. The first step in figuring this out should be to determine if a correlation exists. Then the next step should be to conduct an experimental design which would determine whether or not the classes on creativity and cognitive complexity are improving these levels in students (Campbell, 1979). Determining this should better enable instructors to prepare officers to think at a complex level and to be creative (Costa, 2001). In addition, this research should inform the developing research field of creativity and its connection to cognitive development and complex thinking. This study was conducted at the National Defense University, Joint Forces Staff College in Norfolk, VA; a graduate-level military educational institution with approximately 3,600 students annually. This research used two nationally normalized tests and compared the results. The research questions resulted from an assertion by the Army's Command and General Staff School at Fort Leavenworth, KS, and the Joint Forces Staff College at Norfolk, VA, that pragmatic cognition skills should be taught and evaluated during the same time that creativity is taught and evaluated (*Command and*

General Staff College campaign plan, 2005; Mission of Joint Forces Staff College and Joint and Combined Warfighter School, 2008).

Research Questions

This research endeavors to define the nature of the correlations listed below. In order to define the nature of the correlation the researcher will identify whether the correlation is either positive or negative and identify the strength of the correlation. The following questions guide this study:

1. What is the nature of the correlation between the level of cognitive complexity and the level of creativity in field grade officers at the Joint and Combined Warfighter School? (Primary research question)
2. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and the branch of service (Army, Navy, Air Force, Marines)? (Secondary research question)
3. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and combat experience? (Secondary research question)
4. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and gender? (Secondary research question)
5. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and education level (bachelor's, master's or doctorate)? (Secondary research question)
6. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and age? (Secondary research question)

Design of the Study

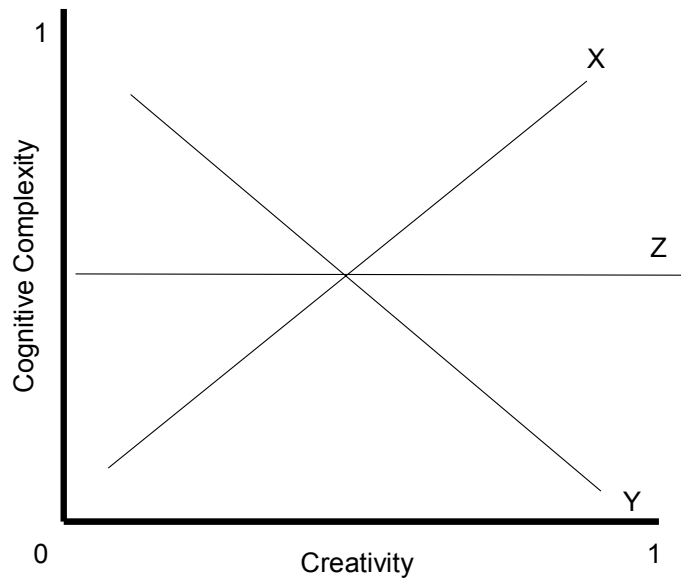
This was a quantitative study that uses a non-experimental, correlational design (Campbell & Cook, 1979, Campbell & Stanley, 1963; Patton, 2002). In this non-experimental design, no treatments are applied. The reason for this research design was to explore the relationships that are present between the measured level of cognitive complexity and the measured level of creativity. In addition, this study described the relationship between the variables of cognitive complexity and creativity and how they covary with branch of service,

gender, combat experience, and education level, and attempted to quantify the strength, direction, relationship and effects of the covariates.

Correlational Studies

Correlational studies are used to look for relationships between variables (level of cognitive development and level of creativity) (Field, 2006). There are three possible results of a correlational study: a positive correlation, a negative correlation, and no correlation. The correlation coefficient is a measure of correlation strength and can range from -1.00 to $+1.00$ (Field, 2006). Positive correlations occur when both variables increase or decrease at the same time such as in Figure 3.1, line X. Therefore a positive correlation would exist if a subject had a high level of cognitive development and a high level of creativity. A correlation coefficient close to $+1.00$ indicates a strong positive correlation. Negative correlations indicate that as the amount of one variable increases, the other decreases, such as line Y. Therefore, an example of a negative correlation would be if there were a high level of cognitive complexity and a conversely low level of creativity. A correlation coefficient close to -1.00 indicates a strong negative correlation. If there is no correlation, it indicates no relationship between the two variables, as shown by line Z where values of cognitive complexity remain the same while creativity increases and decreases. With no correlation, neither variable would have an effect on the other. A correlation coefficient of 0 indicates no correlation (Field, 2006). While correlational studies can suggest that there is a relationship between two variables, they cannot prove that one variable causes a change in another variable. In other words, correlation does not equal causation.

Figure 3.1 Correlations



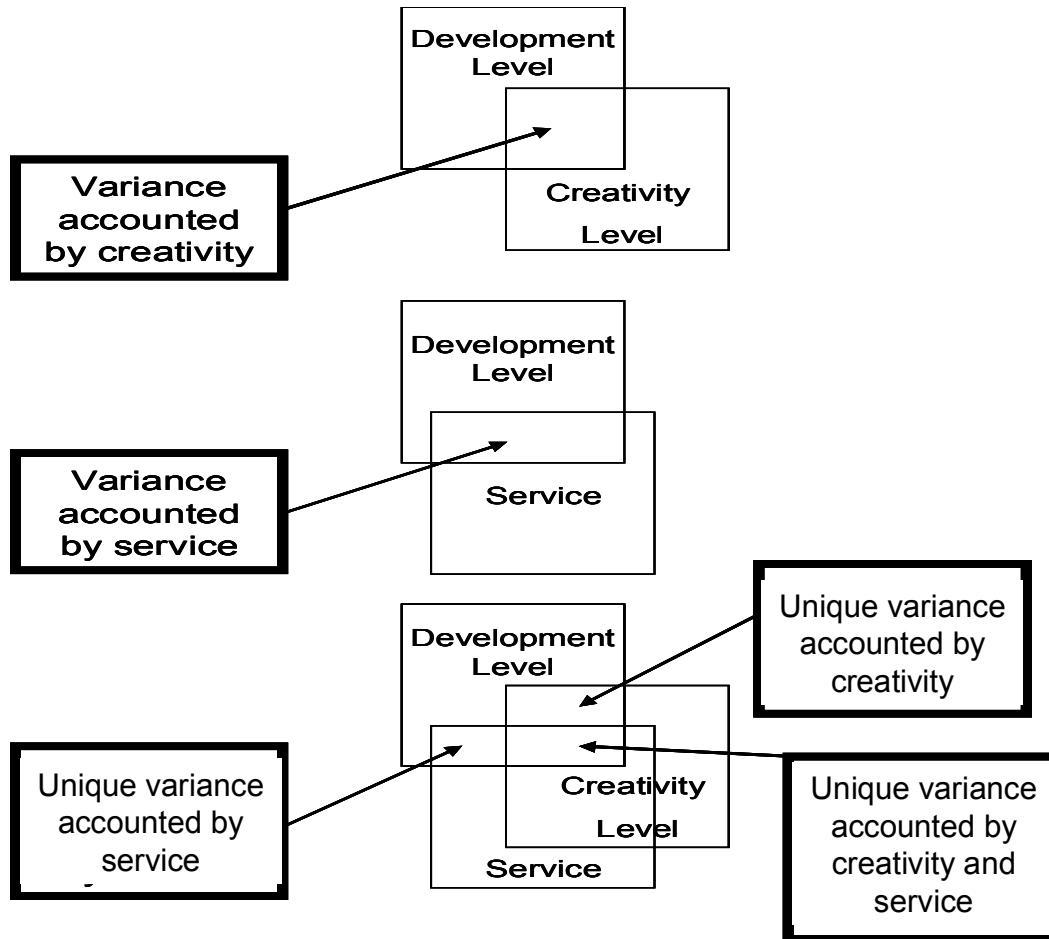
Part and Partial Correlations

These types of correlation analyses were done in order to determine the association of the secondary research questions; accounting for branch of service, age, extent of combat experience, gender, and education level.

Partial Correlations

A correlation between two variables in which the effects of the other variables are held constant is known as a partial correlation. This is illustrated in figure 3.1, where cognitive complexity, creativity, and service variances are taken into account. For this research, a partial correlation was used to determine whether there is a correlation between creativity, cognitive complexity, and branch of service. Figure 3.2 graphically illustrates this procedure.

Figure 3.2 The Principle of Partial Correlation



The following Partial Correlations are evaluated in this study:

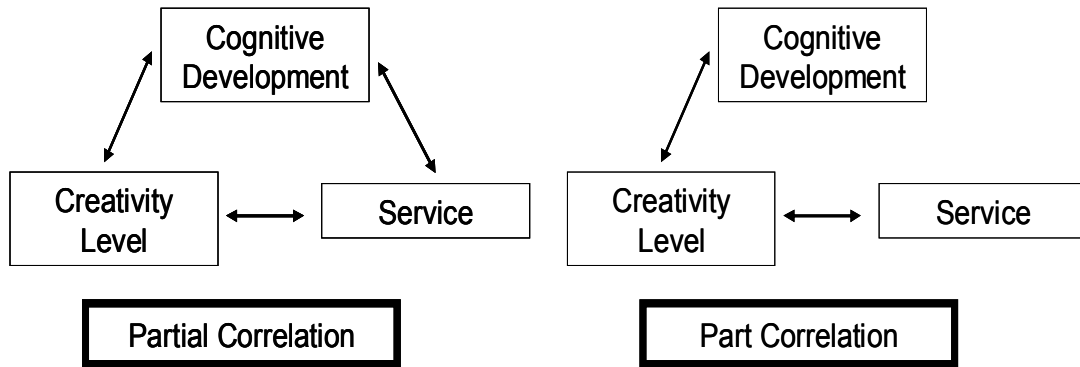
1. Cognitive complexity, creativity and service (research question 2)
2. Cognitive complexity, creativity and combat experience (research question 3)
3. Cognitive complexity, creativity and gender (research question 4)
4. Cognitive complexity, creativity and education level (research question 5)
5. Cognitive complexity, creativity and age (research question 6)

Part (Semi-Partial) Correlations

When partial correlations are calculated, the researcher controls for the effect of the third variable (in the previous example, service). However, when part correlations are conducted, the researcher controls for the effect of the third variable on only one of the other variables (Field, 2006). This type of correlation is helpful when trying to explain the variance in one particular

variable from a set of predictor variables. The difference between the partial and part correlations is illustrated in Figure 3.3.

Figure 3.3 The Difference between Partial and Part (Semi-Partial) Correlations



This research will investigate the following part correlations:

1. Between creativity and cognitive complexity (research question 1)
2. Between creativity and gender
3. Between creativity and combat experience
4. Between creativity and education level
5. Between creativity and service
6. Between cognitive complexity and gender
7. Between cognitive complexity and combat experience
8. Between cognitive complexity and service
9. Between cognitive complexity and education level

Procedure

The researcher first asked the subjects to sign an informed consent form (Appendix D). The subjects then each completed a data sheet requesting the subject's name, branch of service, age, gender, education level, and combat experience (Appendix E). Since normally scheduled classes are in the morning, the testing took place after class in the afternoon. The researcher gave a quick presentation on the research, how the research applied to the subjects, and the significance of the study. The researchers introduced the two instruments that were administered,

and in general, set the conditions for success for administering the two instruments. The researcher briefing to the students was important to achieving reliable and valid results. For the LEP, it is important that the subjects think about their ideal learning environment (Moore, 1989). For the TTCT, it is important that the subjects understand that they are taking a creativity test and that it is suitable to give answers that may not fit into military norms. Due to the length of time it takes to administer the two tests, approximately 1.5 to 2 hours, the researcher was only able to survey one staff group per day. The researcher administered the Learning Environments Preference and then the Torrance Tests of Creative Thinking to each group of subjects. The scores on each of the tests was recorded and put into a database (see Appendixes A and B). The Internal Review Board (IRB) of the Joint Forces Staff College agreed to allow the subjects to be tested by the LEP and the TTCT (Appendix G).

This study was supported by past research and was approved by experts and national authorities in making the combinations of materials and statistics. Past research suggests that creativity and cognitive complexity suggests that the two are related in some way (Vandervert, 2003a; Albert, R. S., & Runco, M. A., 1989; Finke, R. A., Ward, T. B., & Smith, S. M., 1996; Hasirci, D., & Demirkan, H., 2007; Meneely, J., & Portillo, M., 2005). The design was presented to the IRBs at Kansas State University and then the Joint Forces Staff College where approval for the research was granted by both institutions. Approval to use the LEP was granted by Dr William Moore after the research design was presented in written form, where it was understood that the LEP would be correlated to the Torrance tests (See Appendix C). And lastly, the Scholastic Testing Service granted approval to use the Torrance Tests after the research design was presented in both oral and written form where it was understood that the Torrance Tests would be correlated to the LEP.

The Instruments

Learning Environments Preference (LEP)

The Learning Environments Preference (LEP) was developed by Moore (1991). According to Moore, the LEP takes approximately 45 minutes to complete. In addition, the LEP had been used for quarter-and-semester length experiences using the pre/post test design with positive results. The LEP focuses on levels 2 through 5 in Perry's (1970, 1981, 1998) scheme. This instrument describes a consistent pattern of increasing intellectual complexity. "These

domains focus on student preferences for specific aspects of the classroom learning environment shown to be associated with increasing complexity of the Perry scheme of intellectual development” (Moore, 1991, p. 9). It is important, according to Moore, to impress upon the students to keep in mind their ideal learning environment, rather than a specific class or type of class, while completing this instrument (1991). The LEP consists of 65 items divided into five content domains:

1. View of knowledge/learning
2. Role of the instructor
3. Role of the student/peers
4. Classroom atmosphere/activities
5. Role of evaluation/grading

Respondents are asked to rate an item with their perception of its importance in an ideal learning environment. Items within each domain are rated on a Likert-type scale of 1-4. Respondents then rank the three items from each domain most significant to them personally. The items begin with the least complex and are followed by a mixture of more complex ideas. The LEP was developed to evaluate college undergraduate level of development; however, Moore (1991) found that the instrument worked equally as well with determining the cognitive development in graduate students, such as those at JCWS.

The LEP is grounded in qualitative data collected on the Perry scheme over the last decade (Baxter Magolda, 1992; Moore 1989). The LEP was derived from another instrument, the Measure of Intellectual Development (MID) at the Center for the Study of Intellectual Development in Olympia, WA. Lee Knefelkamp, Clyde Parker, and Carol Widick (1978) designed the original MID instrument that consists of sentence stems and semi-structured essay tasks. It evolved to the current instrument that focuses exclusively on issues related to classroom learning. Moore (1989) who was interested in Perry’s positions that could be administered to a large group of participants and objectively scored, began with the MID as his base. Each item was assigned to Perry positions 2 through 5.

The initial pilot study by Moore used a group of 51 sophomores at a private liberal arts college. They were administered both the LEP and the MID. The Cognitive Complexity Index (CCI) and the R-Index (the score on position 5 that correlated to relativistic thinking) from the LEP and MID mean were compared to the students’ ACT and grade point averages (GPA). The

MID and CCI correlated $r = .38$ with each other, and both about the same with GPA ($r = .36$ and $.34$ respectively). The R-Index correlated poorly with the MID ($-.01$), GPA ($-.014$), and ACT ($-.06$), but well with the CCI ($.46$).

Several items were revised and a second pilot study involving 34 undergraduate students at a Midwestern private liberal arts college was conducted. In this study the R-Index performed better, and the CCI and MID correlation rose to $r = .57$. The most important issue for any test is validity. There are three kinds of validity: construct validity, criterion validity, and concurrent validity. In terms of reliability, there are three types of interrelated reliability concerns that should be addressed: stability, equivalence, and internal consistency.

Reliability and validity for the LEP was conducted with 725 undergraduate students at several institutions. The students were 47% male, 53% female: 38% freshman, 34% sophomores, 10% juniors and 18% seniors. Psychometric reliability was assessed for the LEP through internal consistency and test-retest. There is concern of the effect of testing using test-retest designs (Campbell & Stanley, 1963) Cronbach's coefficient alpha, the single most important measure of internal consistency for this type of instrument, was used (Moore, 1989). It was computed for each domain of the LEP with alpha reliability coefficients from $r = .63$ to $.68$ and by position with ranges of $r = .72$ to $.84$. A one-week retest reliability study with 30 students was conducted, and the CCI showed a correlation of $r = .89$, indicating a reasonable amount of stability.

Validity was assessed for the LEP through construct validity, criterion group differences, and concurrent validity. Construct validity was addressed for the LEP by using ANOVA for gender and class on the CCI. There were significant differences across class level, but no significant differences were found by gender. The interaction of class and gender was not significant. Concurrent validity focused on correlations of the CCI and MID scores and GPAs. The correlation with the MID produced a correlation of 0.36 and with GPA of $r = .18$.

The CCI score is the primary score of interest for the LEP, reflecting a numerical index along a continuous scale on cognitive complexity from 200-500, roughly analogous to Perry 2 (200) to 5 (500) positions. According to Moore (1989, 1991), it is best to think of the CCI score as a more general indicator of increasing cognitive complexity. The LEP validity and reliability studies indicated the LEP accurately measures cognitive development (Moore, 1989). The LEP was chosen because it is the most widely recognized instrument for evaluating Perry's scheme: it has an amount of validity and a high amount of reliability (Moore, 1994).

Torrance Tests of Creative Thinking (TTCT)

The Torrance Tests of Creative Thinking (TTCT) were developed by Dr. Ellis Paul Torrance and his associates in 1966. The tests have been renormalized six times, in 1974, 1984, 1990, 1998, 2002 and 2007(Torrance, 2008a, 2008c). There are two forms (A and B) of the TTCT-Verbal and two forms (A and B) of the TTCT-Figural. Scholastic Testing Service, Inc. in Bensenville, IL, holds the copyright for the TTCT and provided a norms manual for the 2007 version of the test. The TTCT can be administered as an individual or group test and can be used for kindergarten through adult. The tests require 30 minutes per test of working time, so speed is important, while artistic quality is not required to receive credit.

The TTCT was a part of a long-term research program emphasizing classroom experiences that stimulate creativity (Torrance, 1966). Torrance (1966, p. 6; 1972, 1974a, 1974b) defined creativity as:

A process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results.

Torrance (1966, 1974a and 1974b) suggested the following uses for the test:

1. To understand the human mind and its functioning and development
2. To discover effective bases for individualizing instruction
3. To provide clues for remedial and psychotherapeutic programs
4. To evaluate the effects of educational programs, materials, curricula, and teaching procedures
5. To be aware of latent potentialities

In other words, the original purposes of the TTCT-Verbal and Figural were for research and experimentation, general use for instructional planning, and determining possible strengths of students. Therefore, the purposes are for inclusion of higher scoring students-rather than exclusion of lower-scoring students for individualizing instructional programs (Treffinger, 1985). Those purposes appear to be adequate for assessment of gifted children, as well as for determining creativity levels in others. This is especially true for TTCT-Figural, since most

assessments for gifted children focus more on verbal and quantitative ability. The TTCT-Figural allows another perspective of the student's ability, and it can be less biased for English as second language speakers (Torrance, 1979). In addition to assessments of gifted children, the TTCT appears to be reliable for determining the creativity levels of non-gifted subjects as well (Treffinger, 1985).

Although there have been several revisions of the TTCT-Figural manual, the test itself has remained unchanged. The first edition in 1966 measured *fluency*, *flexibility*, *originality*, and *elaboration*, which were taken from the divergent-thinking factors found in Guilford's dimensions of aptitude (Guilford, 1959; Torrance, 1966).

The scoring was as follows:

1. *Fluency*: the number of interpretable, meaningful, and relevant responses to the stimulus.
2. *Flexibility*: the variety of categories of relevant responses.
3. *Originality*: responses which are unexpected, unusual, unique or statistically rare.
4. *Elaboration*: the addition of pertinent details. (Torrance, 1966).

The second edition measured the same four scoring variables as that of 1966 (Torrance, 1974a). The stimuli of the TTCT of 2007 are identical to that of 1966 and 1974. However, the scoring procedures were changed in the sixth edition TTCT of 2007. Two norm-referenced measures of creative factors, *abstractness of titles* and *resistance to premature closure*, were added to *fluency*, *originality*, and *elaboration*; but the measure of *flexibility* was eliminated. Thirteen criterion-referenced measures that Torrance (1987a, 1987b) called *creative strengths* were also added to the scoring. The creative strengths were emotional expressiveness, storytelling articulateness, movement or action, expressiveness of titles, synthesis of incomplete figures, synthesis of lines or circles, unusual visualization, internal visualization, extending or breaking boundaries, humor, richness of imagery, colorfulness of imagery, and fantasy.

After 1984, the TTCT manuals were given a different scoring system for *originality*. The manual provides a list of statistically frequent and usual responses given by a national sample of 500 subjects. *Originality* scores are based upon the list, in that any of the subject's responses that are found on the list receive a score of zero (Torrance, 2008d, 2008e).

The scoring aspects of the fourth and fifth editions of 1990 and 1998 were identical to the 1984 edition of TTCT in that it was scored by 5 norm-referenced measures and 13 criterion-

referenced measures. The TTCT is scored for *fluency*, *originality*, and *elaboration* in the same way as in earlier editions; but is now scored for *abstractness of titles* by the level of abstraction given to the titles of the pictures drawn and for *resistance to premature closure* by the ability to remain open in processing information and the consideration of the variety of information given in responses (Torrance, 2007). After 1990, the TTCT-Figural manual presented a simplification of the scoring procedures, and also provided a detailed scoring workbook in addition to the Norms-Technical Manual (both manuals provided by the Scholastic Testing Service).

The TTCT-Figural has two parallel forms, A and B, and consists of three activities: picture construction, picture completion, and repeated figures of lines or circles. They require 10 minutes to complete each activity. In activity one, the subject constructs a picture using a pear or jelly bean shape as a stimulus on the page. The stimulus must be an integral part of the picture construction. Activity two requires the subject to use ten incomplete figures to make and to name an object or picture. The last activity is composed of three pages of lines or circles which the subject is to use as a part of his or her picture (Torrance, 1966, 1974a, 1974b, 2007).

The TTCT-Figural manual of 2007 provided the internal consistency reliability from the KR-21 estimates. On the manual, it says, “TTCT Norms Technical Manual (published by STS in 2007) includes a summary of predictive validity studies, correlations with other testing instruments, inter-rater reliability, and other related information” (Torrance, 2007, p. 42).

The reliability estimates of the creative index from the KR-21, using 99th percentile scores as the estimates of the number of items, ranged between .89 and .94, which are good, in comparison with those from other high-stakes tests such as Graduate Record Examinations (GRE), for which the KR-20 are reported as .93 for the verbal score, .91 for the quantitative score, and .86 for the analytic score (Jaeger, 1985).

According to the TTCT-Figural manual of 2007, the inter-rater reliability was above .90 (Torrance, 2007). According to the TTCT-Figural manual of 1966, 1974a, and 1974b, the test-retest reliability coefficients are varied (around .50), but Torrance indicated that motivational conditions affect the reliability (Torrance, 1966, 1974a, 1974b). Therefore, given the complexity of creative thinking, the TTCT-Figural can be seen as having reasonable reliability (Treffinger, 1985).

There have been many validity studies of TTCT. In terms of predictive validity, TTCT scores have been significantly correlated with creative achievement in the 9-month, 7-year, 22-

year, and 40-year longitudinal studies (Millar, 2002; Torrance & Wu, 1981). Torrance's (2002) 22-year longitudinal study concluded that the creative index is the best predictor for adult creative achievement. Torrance found that adult creative achievement is explained by the TTCT score about 50%, which is three times larger than that of an IQ score.

The interpretation using the scoring system of TTCT 1966 might be different from that of TTCT of 2007, but the predictive validity is hypothesized as equally good for the TTCT of 2007, since the test itself has not changed. The 18 case studies from the sample of 391 students in the original study from 1958 to 1964 show a high correlation between elementary school children's creativity scores and their 40-years-later creativity (Millar, 2001).

In terms of concurrent validity, Gonzales and Campos's (1997) study showed that the scores of the Spatial Test of Primary Mental Abilities (PMA) and the Gordon Test of Visual Imagery Control are significantly correlated with the TTCT score. Even though the correlation coefficients are not high, this would indicate that imagery is significantly correlated with various aspects of creative thinking, such as:

Fluency: (PMA: $IQ > 120 = .18$, $IQ < 120 = .14$, $p < .001$; Gordon: $IQ > 120 = .20$, $IQ < 120 = .09$),

Originality: (PMA: $IQ > 120 = .36$, $p < .001$, $IQ < 120 = .18$, $p < .001$; Gordon: $IQ > 120 = .30$, $p < .01$, $IQ < 120 = .11$, $p < .01$),

Resistance to premature closure: (PMA: $IQ > 120 = .33$, $p < .001$, $IQ < 120 = .02$, $p < .001$; Gordon: $IQ > 120 = .26$, $p < .01$, $IQ < 120 = .02$, $p < .001$).

In terms of content validity, Torrance (1966, 1974a, 1974b) mentioned on the TTCT manuals of 1966 and 1974 that analyses of eminent persons' lives, research concerning their personalities, and research and theory on the human mind had been the bases for the test stimuli, instructions, and scoring procedures in order to ensure content validity of the TTCT. Therefore, it can be hypothesized that it has adequate content validity, especially because it has been developed by Torrance, an expert in the field of creativity. As a result, both the recent validity studies and the validity studies shown on the TTCT-Figural manual of 2007 suggest acceptable validity of the TTCT. The items and test scores of the TTCT may fulfill the purposes stated by Torrance.

The manual provides norms generated in the summer of 2007, which includes both grade-related norms (kindergarten through grade 12) and age-related norms (ages 6 to 19 and above),

using a huge sample size of 55,600 students, grades K-8, secondary, and adult. The real age range of the norm groups is not reported, although both grade-related and age-related norms are provided on the manual. Geographic differences are reported by grouping the states into four regions used by the National Assessment of Educational Progress, the U.S. Department of Commerce, and the National Education Association. The demographic characteristics, such as, sex, race, community status, and English as second language speakers, were not outlined. This could be the result of assumptions on the author's part that the TTCT is fair with regard to race, socioeconomic status, and culture (Cramond et al., 2005; Torrance, 1979).

For a person who had TTCT scoring training, either in person through one of the seminars or by reviewing the manuals provided by the Scholastic Testing Service, the scoring procedures are quite systematic and methodological. Compared to the subjectivity of many IQ tests and other psychological tests, the scores of the TTCT can be objective. It is not surprising that it has high inter-rater reliability as long as the scorers follow the directions of the scoring guide figural A and B.

The information, including the Norms-Technical Manual, Streamlined Scoring Guide, and other test materials, provided by Scholastic Testing Service is clear, usable, and engaging. The tests are easily administered and take only 30 minutes, so that they are suitable for group use (Torrance, 2008b, 2008f). Test anxiety is not an issue in the TTCT because administrators of the tests should invite the examinees to enjoy the activities; the tests should not be viewed as tests but as fun activities, according to the administration of the TTCT-Figural in the manual (Torrance, 1987a, 1987b).

The TTCT-Figural has had 25 years of extensive development and evaluation (Millar, 2002). It has one of the largest normalized samples, and valuable longitudinal validations and high predictive validity over a wide age range (Cropley, 2002). The TTCT-Figural can be fair in terms of gender, race, and community status, and for persons with who have different languages, socioeconomic status, and cultures (Torrance, 1979; Cramond et al., 2005). From an educational point of view, using the TTCT-Figural is desirable because it is based upon Torrance's philosophy of advocating creativity and the creative potentials of all people of all ages and abilities, as well as the creativity of the gifted and talented.

The TTCT-Figural seems to display adequate reliability and validity (Cooper & Jayatilaka, 2006 Treffinger, 1985) for the purposes of the test. It has some desirable features

compared to other creativity tests and psychological tests. It has fewer limitations and cautions to apply and is more researched and analyzed than any other instrument (Treffinger, 1985).

Treffinger cautioned that the TTCT-Figural provides useful insights into creativity as long as the tests are used with sensitivity and good judgment by qualified personnel because variations in testing procedures can affect their scores. This instrument serves well the purposes for which Torrance intended. Although the tests have been used mostly for assessment for identifying gifted children, Torrance originally planned to use it as a basis for individualizing instruction for different students based on the test scores (Torrance, 1966, 1974a, 1974b).

According to Torrance (2002), creative motivations and skills, as well as creative abilities, are necessary in order for adult creative achievement to occur. In addition, Cropley (2002, 2006) recommended using the TTCT, focused on assessment of potential and on the use of tests as a basis for differentiated counseling. Runco (1986) suggested using multiple indicators of creativity for assessment, based on the purpose.

The TTCT is translated into 35 languages (Millar, 2002). It is highly recommended in the educational field and is even used in the corporate world of business. It is the most widely used test of creativity (Colangelo & Davis, 1997) and had the most scholarly references of all creativity tests. The standard administration and scoring procedures (Davis & Rimm, 1994), as well as the development and evaluation (Colangelo & Davis), have made the TTCT especially useful for identifying gifted and talented students. Therefore, the TTCT appears to be a good measure not only for identifying and educating the gifted, but also for discovering and encouraging everyday life creativity in the general population.

The Population

The population the researcher sampled was a cross-section of field grade officers ($N = 250$) attending the Joint and Combined Warfighter School (JCWS) at Norfolk, VA, during class 08-2, 14 January 2008 to 21 March 2008. All of these officers had the following attributes in common: at least 12 years of active duty military experience, held a bachelor's degree, and were either Majors (Army, Air Force, Marine), Lieutenant Commanders (Navy), Lieutenant Colonels (AF, Army, Marine), Commanders (Navy), Captains (Navy) or Colonels (Army, AF, Marine). Most had combat experience. All of them were either coming from or going to a joint assignment (assigned to a headquarters that has multiple branches of service). Most were male and between

the ages of 35 and 45. They attended this school for a 10-week course on joint force operations to gain an appreciation for “jointness” (Clark, 2008). The Joint Professional Military Education II, also known as the Joint and Combined Warfighting School (JCWS), educates military officers and national security leaders in operational level planning with a focus on joint, multinational, and interagency issues. The 10-week curriculum, implemented in 2005, had at its core the new Joint Operational Planning Process. The curriculum incorporated emerging joint doctrine and reflected the realities of the modern security environment, with a significant emphasis on irregular warfare, stability operations, homeland defense, and consequence management. It was redesigned by adding instruction on complex thinking and creativity in order to address the increasingly complex security environment found most notably in dealing with the multifarious political and religious aspects of the worldwide radical Islam movement (Joint Forces Staff College, 2007).

The Sample

The researcher sampled this population during the 14 January 2008 to 21 March 2008, JCWS class. The researcher received authorization from the Joint Forces Staff College Commandant and the National Defense University’s IRB to survey seven, 18-person staff groups ($n = 126$). The sample size was 126 from a population of 250, approximately half of the population. Each staff group was purposefully assembled by the Staff College. The Staff College selects staff group members in order to have equal representation of branch of service, gender, race and ethnicity, and experience in each of the staff groups. Therefore, each of the staff groups that were sampled was a purposefully selected cluster within the Staff College.

Recording and Scoring of Data

The LEP is a copyrighted test. Approval to use the LEP was gained from Dr. William S. Moore and The Center for the Study of Intellectual Development (see Appendix C). In addition, The Center for the Study of Intellectual Development is the sole repository for scoring of the LEP. LEP instruments were submitted to the Center upon completion by the subjects. The Center provided a summary sheet, including all demographic information, position sub-scores, and the overall CCI (Cognitive Complexity Index) score, plus basic summary statistics as requested by the researcher.

The TTCT-Figural can be scored either by the researcher or by the Scholastic Testing Service. With the *Figural TTCT Streamlined Scoring* booklet provided by the Scholastic Testing Service, the researcher can use age-related norms to score the surveys. Age-related norms are based on the typical age for each of the grades in which the Figural TTCT is used. They range from 5 to 18 years and beyond (Torrance, 1974a, 1974b). Using the *Figural TTCT Norms-Technical Manual* provided by the Scholastic Testing Service, the researcher can use national norm tables with standard scores and national percentiles by age for each scored area. The tables also show national percentiles for average standard scores, as well as a creativity index developed from the five standardized scores and thirteen creative strengths (Torrance, 2008a). The TTCT-Verbal can be scored by either the researcher or the Scholastic Testing Service. The *Manual for Scoring and Interpreting Results* and the *Verbal Norms-Technical Manual* provided by the Scholastic Testing Service, gives a scoring methodology that includes 2007 national norm tables with standard scores and national percentiles by age for each score area (Torrance, 2008a, 2008c, 2008d, 2008e).

The TTCTs were scored by the Scholastic Testing service. In order to increase the validity and reliability of the analysis and eliminate any researcher bias, the researcher elected to have the Scholastic Testing Service score the TTCT Figural and Verbal tests. See Appendix A for all of the LEP and TTCT scores.

Data Analysis

The Statistical Package for the Social Sciences (SPSS) was used for all statistical analyses on the data set. The data sets from the seminars were combined into one final sample. Descriptive statistics, including frequencies, measures of central tendency, and measures of variation were used to analyze the diversity of the sample as to rank, gender, combat experience, branch of service, and education level, with respect to the scores on the LEP and TCTT. Analysis of the data included a determination of whether the data were normally distributed. The data were not normally distributed, so the Kendall tau correlation coefficient for non-parametric data sets was used to make bivariate correlations. When partial correlations were conducted the data was normalized by converting to standardized variables; normal scores, z-scores or z-values (Field, 2005).

Correlation analysis measured the relationship between the CCI scores on the LEP and the scores on the TTCTs. Additionally, correlation analysis measured the relationship between the CCI scores on the LEP, the scores on the TTCTs, while controlling for the covariates of age, gender, rank, branch of service and combat experience. Also, correlation analysis measured the relationships between the CCI scores on the LEP and each of the following variables: age, gender, rank, branch of service, and combat experience. Correlation analysis measured the relationships between scores on the TTCTs and each of the following variables: age, gender, rank, branch of service, and combat experience. An overall correlation analysis measured the relationships between CCI scores on the LEP, scores on the TTCTs, age, gender, rank, branch of service, and combat experience, using step wise progression. See Appendix H for the Kendall Tau *b* bivariate correlations.

Protection of Human Rights

Approval for the study of human subjects was granted on 14 January 2008, through the Kansas State University Institutional Review Board (IRB). The Joint Forces Staff College consented verbally and through e-mail communication to this study. The primary factors in the approval from Joint Forces Staff College were that this was not an experiment but a study, and the two survey instruments being used had a high degree of reliability and validity. Additionally, Joint Forces Staff College requested that personal scores must be provided to all students who requested them. Neither the paper copies of the LEP and TTCT nor the names of the subjects were linked directly to the data and research results. Data were not presented in a manner that would compromise the subjects' confidentiality.

Summary

The purpose of this study was to investigate whether a relationship exists between cognitive complexity levels and the levels of creativity in field grade officers at the Joint and Combined Warfighter School. The researcher compared the results of two nationally normalized tests, the LEP and the TTCT. This research attempted to answer the questions: does an association exist between the level of cognitive complexity and level of creativity in field grade officers at JCWS? How do the variables of age, gender, education level, and combat experience affect the level of cognitive complexity and level of creativity?

This study used a non-experimental, correlational design (Campbell & Cook, 1979; Campbell & Stanley, 1963; Patton, 2002). In this non-experimental design, no treatments were applied. This non-experimental design could not predict causal relationships, but instead studied naturally occurring variation in the measured variables without any intervention. The reason for this research design was to explore the phenomena that occur between the level of cognitive complexity and the level of creativity in field grade officers at the Joint and Combined Warfighting School at Norfolk, VA, in order to understand cognition and creativity in greater detail, to attempt to identify variables that affect cognition and creativity, and to assist in the development of curriculum at the Department of Defense educational institutions.

CHAPTER 4 - Findings

Overview

Data collected as a result of this research are presented in this chapter. Quantitative data describe various characteristics about the participants in the study and answer the research questions. The demographic data includes the collection age, military rank, branch of military service, military and civilian schooling, combat experience, and gender to describe the sample and find correlations between demographics and test scores. The cognitive complexity scores of the officers participating in the study were reported to describe the cognitive thinking levels of the officers. The Torrance Tests of Creative Thinking (TTCT) scores were collected to describe the level of creativity of the officers. For purposes of discussion, the quantitative data are divided into five sections. The first section describes the demographics of the sample. The second and third sections describe the results of the Learning Environments Preference (LEP) and TTCT scores. The fourth section discusses the nature of the correlation between creativity and cognitive development in the sample. The fifth section discusses other correlations found in the research.

Demographics

The Sample

The sample was taken from the Joint and Combined Warfighter School (JCWS) at the Joint Forces Staff College. Seven of fourteen staff groups from class 02-08 (14 January 2008 thru 21 March 2008) were sampled, for a total sample of 126 from a population of 250 ($n = 126$, $N = 250$). While military officers from allied countries attend JCWS, none were sampled. In addition, two staff groups made up entirely of O-6's (Colonels and Navy Captains), were not sampled (See Fig 4.1).

Age

Ages of the sample ranged from 34 to 44, with a mean age of 39.5, and mode and median of 40.

Gender

JCWS was/is predominantly male. The Joint Forces Staff College attempts to have at least one female represented in each of the staff groups, but this is not always possible. There were 14 females sampled, which represented 11% of the sample population. This percentage is representative of females in the military in general. The small number of female officers attending the school limited the amount of data that could be collected.

Military Service

The Army, Navy, Air Force, and Marine Corps were all part of the sample population. There were no civilians, nor were there other agencies within the Department of Defense represented in the sample (i.e., Coast Guard). There were 12 Marines (9.5%), 42 Air Force officers (33.3%), 30 Navy officers (23.8%), and 42 Army officers (33.3%) in the sample.

Military Rank

Only two military ranks were sampled because only field grade officers attend JWCS and the researcher was not allowed to survey O-6s; only O-4s (Army, Air Force and Marine Majors, and Navy Lieutenant Commanders) and O-5s were sampled (Army, Air Force and Marine Lieutenant Colonels, and Navy Commanders). There were 60 O-4s (47.6%) and 66 O-5s (52.4%).

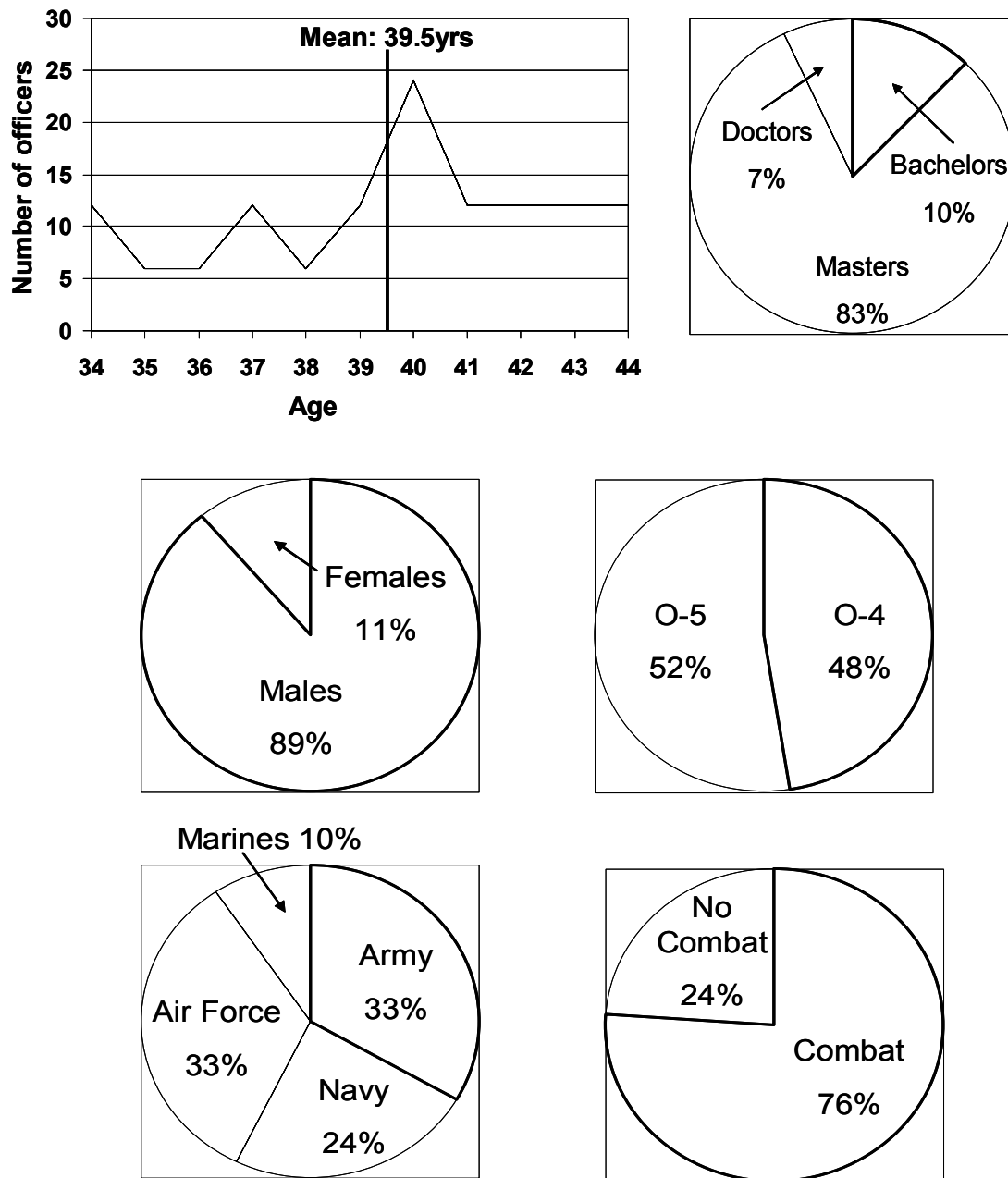
Combat Experience

Most of the officers attending JCWS had combat experience. Ninety-six (76.2%) of the officers had combat experience, with an average length of time in combat of 19 months. Of the 96 officers with combat experience, 53 (55.2%) reported that they were involved in direct combat, while 43 (44.8%) reported that they were in a combat theater but not involved in direct combat.

Education

All of the officers sampled had at least a bachelor's degree. Additionally, master's degrees were held by 105 (83.3%) and 9 held doctorates (7.2%). All of the officers sampled had attended a service Staff College, with 6 (4.8%) officers reporting that they had attended a service War College (normally attended by O-6s/Colonels/Navy Captains).

Figure 4.1 Sample Demographics



LEP Results

The Learning Environments Preference (LEP) instrument was administered to the entire sample and scored by the Center for the Study of Intellectual Development (CSID). The LEP CCI scores ranged from 260 to 443. As shown in Table 4.2, the mean score was 391, with a

median score of 403, which according to CSID, corresponds approximately to a Perry position 4, Relativism (Table 4.1).

Table 4.1 LEP CCI, the Perry Positions and Number of Subjects in Each Category

Number of Subjects	LEP CCI Score	Perry Position
0	200-240	Position 2: Dualism
5	241-284	Transition between 2 / 3
7	285-328	Position 3: Multiplicity
22	329-372	Transition between 3 / 4
45	373-416	Position 4: Relativism
47	417-460	Transition between 4 / 5
0	461-500	Position 5: Commitment to Relativism

This is generally what would be expected from a sample population where most people have masters' degrees and an average age of 40 (Moore, 2008). Surprisingly, none of the subjects attained scores above 461, or a score analogous to the Perry position 5, Commitment to Relativism. The researcher can not explain any non-obvious reason for all of the scores being under 461, other than none of the officers are thinking at that level.

Table 4.2 LEP Descriptive Statistics

			Statistic	Std. Error
LEP Scores	Mean		391.0238	3.88641
	95% Confidence Interval for Mean	Lower Bound	383.3321	
		Upper Bound	398.7155	
	5% Trimmed Mean		394.9268	
	Median		403.0000	
	Variance		1903.127	
	Std. Deviation		43.62485	
	Minimum		260.00	
	Maximum		443.00	
	Range		183.00	
	Interquartile Range		56.00	
	Skewness		-1.204	.216
	Kurtosis		1.223	.428

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
LEP Scores	.136	126	.000	.887	126	.000

The distribution of LEP CCI scores was not normal. The scores were negatively skewed (-1.204) toward higher scores. The LEP CCI scores were leptokurtic (1.223). The mean and median scores ranged by greater than 5%, probably because most of the scores were in the upper range of scores (causing the range to be negatively skewed). The LEP CCI scores failed the Kolmogorov-Smirnov and Shapiro-Wilk tests for normality at $p < .05$, and when compared against the TTCT scores failed the Levine Test for homogeneity of variance

Torrance Tests of Creative Thinking Results

The Torrance Tests of Creative Thinking Verbal form and Figural form were both administered to the entire sample population and scored by the Scholastic Testing Service. Scores are reported as raw scores on a scale of 0-160, percentile ranks on a scale of 1-99%, and normalized standard scores with a mean of 100 and a standard deviation of 20. Only the raw scores were used in the correlation analysis. The normalized standard scores were directly derived from percentile ranks. All of these scores were either against a national sampling by

grade or a national sampling by age. Given the sample population at JCWS, the grade and age national sampling scores were essentially the same, so the age normalized scores were used.

TTCT-Figural

The mean raw score for the TTCT-Figural was 107, which is in the 47th percentile, when compared to other individuals in this age group nationally, slightly below average (Torrance, 2008d and e)(Table 4.3). The range of scores was between 76 (3rd percentile) and 133 (95th percentile) (Torrance, 2008d and e).

Table 4.3 TTCT-Figural Descriptive Statistics

			Statistic	Std. Error	
TTCT figural raw score	Mean		107.1587	1.49252	
	95% Confidence Interval for Mean	Lower Bound	104.2049		
		Upper Bound	110.1126		
	5% Trimmed Mean		107.3386		
	Median		102.5000		
	Variance		280.679		
	Std. Deviation		16.75347		
	Minimum		76.00		
	Maximum		133.00		
	Range		57.00		
	Interquartile Range		29.25		
	Skewness		.071		.216
	Kurtosis		-1.318		.428

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
TTCT figural raw score	.163	126	.000	.929	126	.000

The distribution of the TTCT-Figural scores was not normal. The scores were slightly positively skewed (.071), which was not significant, but were extremely platykurtic (-1.318). The mean and median scores ranged by greater than 5%, with a mean of 107 and a median of 102.5. The TTCT-Figural scores did not pass the Kolmogorov-Smirnov or the Shapiro-Wilk tests for normality at $p < .05$ and when compared to the LEP CCI scores, failed the Levine Test for homogeneity of variance.

TTCT-Verbal

The mean raw score for the TTCT-Verbal was 110, which is in the 67th percentile when compared to other individuals in this age group nationally; moderately above average (Torrance, 2008d and e) (Table 4.4). The range of scores was between 90 (32nd percentile) and 133 (95th percentile) (Torrance, 2008d and e).

Table 4.4 TTCT-Verbal Descriptive Statistics

		Statistic	Std. Error
TTCT verbal raw score	Mean	110.4286	1.05309
	95% Confidence Interval for Mean	108.3444	
	Lower Bound		
	Upper Bound	112.5128	
	5% Trimmed Mean	110.3474	
	Median	112.0000	
	Variance	139.735	
	Std. Deviation	11.82095	
	Minimum	90.00	
	Maximum	133.00	
	Range	43.00	
	Interquartile Range	19.25	
	Skewness	.106	.216
	Kurtosis	-1.075	.428

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
TTCT verbal raw score	.087	126	.019	.961	126	.001

a Lilliefors Significance Correction

The distribution of the TTCT-Figural scores was not normal. The scores were slightly positively skewed (.106), which was not significant, but were extremely platykurtic (-1.075). The mean and median scores ranged by less than 5%, with a mean of 110 and a median of 112. The TTCT-Figural scores did not pass the Kolmogorov-Smirnov or the Shapiro-Wilk tests for normality at $p < .05$, and when compared to the LEP CCI scores, failed the Levine Test for homogeneity of variance.

TTCT Composite Scores for Each Subject

The TTCT-Figural and TTCT-Verbal scores were tested for correlation using Kendall's Tau *b*. Kendall's Tau *b* was used because both sets of data (Figural and Verbal) violated assumptions for parametric tests and there is much research to suggest that Kendall's Tau statistic is a better estimate of the correlation in a population than other non-parametric tests such as the Spearman correlation coefficient (Field, 2005).

Table 4.5 TTCT-Figural and Verbal Correlation

			TTCT figural raw score	TTCT verbal raw score
Kendall's tau_b	TTCT figural raw score	Correlation Coefficient	1.000	.723(**)
		Sig. (2-tailed)	.	.000
		N	126	126
	TTCT verbal raw score	Correlation Coefficient	.723(**)	1.000
		Sig. (2-tailed)	.000	.
		N	126	126

** Correlation is significant at the 0.01 level (2-tailed).

There is a strong positive correlation between the Figural and the Verbal scores, as seen in Table 4.5 ($\tau = .723, p < .001$). Since the scores were strongly positively correlated, the Figural and Verbal raw scores were averaged to generate a TTCT composite score. This was done for two reasons. First, it allows for a more balanced TTCT score because it takes into consideration the ability to be creative in both a verbal and figural domain. Second, it was generally accepted practice to combine the scores of the TTCT figural and verbal scores to find one overall creativity score that takes into consideration creativity as it manifests itself in both pictures and words (Torrance, 2007 and 2008d).

The mean score for the TTCT-Composite was 109, which is in the 57th percentile when compared to other individuals in this age group nationally; moderately above average (Table 4.6) (Torrance, 2008d and e). The range of scores was between 84 (19th percentile) and 132 (94th percentile) (Torrance, 2008d and e).

Table 4.6 TTCT-Composite Scores Descriptive Statistics

			Statistic	Std. Error
TTCT average raw score	Mean		108.7976	1.24344
	95% Confidence Interval for Mean	Lower Bound	106.3367	
		Upper Bound	111.2585	
	5% Trimmed Mean		108.8360	
	Median		106.2500	
	Variance		194.813	
	Std. Deviation		13.95753	
	Minimum		83.50	
	Maximum		132.00	
	Range		48.50	
	Interquartile Range		24.63	
	Skewness		.105	.216
	Kurtosis		-1.225	.428

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
TTCT average raw score	.123	126	.000	.946	126	.000

a Lilliefors Significance Correction

The distribution of the TTCT-Composite scores was not normal. The scores were slightly positively skewed (.105), which was not significant, but were extremely platykurtic (-1.225). The mean and median scores ranged by less than 5%, with a mean of 109 and a median of 106. The TTCT-Figural scores did not pass the Kolmogorov-Smirnov or the Shapiro-Wilk tests for normality at $p < .05$, and when compared to the LEP CCI scores, failed the Levine Test for homogeneity of variance.

Correlation between Creativity and Cognition

The first research question was: What is the nature of the correlation between the level of cognitive complexity and the level of creativity in field grade officers at the Joint and Combined Warfighter School? There was a small positive correlation between the measured levels of cognitive complexity and the measured levels of creativity in field grade officers at the Joint and Combined Warfighter School, but it was not statistically significant, as seen in Table 4.7 ($\tau = .083$). See Appendix H for all of the Kendall Tau b correlations.

Table 4.7 Correlation between Creativity and Cognition

			LEP Scores	TTCT average raw score
Kendall's tau_b	LEP Scores	Correlation Coefficient	1.000	.083
		Sig. (2-tailed)	.	.177
		N	126	126
	TTCT average raw score	Correlation Coefficient	.083	1.000
		Sig. (2-tailed)	.177	.
		N	126	126

This research question is answered by correlating the LEP CCI scores and the TTCT-Composite scores using the Kendall’s Tau *b* statistic, which measures the association between rank orders. As mentioned before, Kendall’s Tau was used because both sets of data violate assumptions of parametric tests and there is research that indicates that Kendall’s Tau is a better estimate of the correlation than the Spearman Rho (Field, 2005). The reason is because the Kendall’s Tau takes into consideration in its calculation how the correlation would be affected by comparing the population sets of data as opposed to the sample sets of data – the effect of outliers would be less and there would be more scores near the “center” of a population (Field, 2005). The researcher did try converting the data to standard scores in order to normalize both sets of data and use the Pearson Rho statistic; however that in fact did not significantly change the results of the correlation. Furthermore, the researcher decided not to normalize any data for this bivariate correlation because there were only two sets of data being compared and by converting the data and using another statistic other than the Kendall Tau, the researcher would have lost statistical power (Kendall’s Tau provided more statistical power). When the researcher compared more than two sets of data all of the data were converted to standard scores; z-scores.

While there was a weak positive correlation, the *p* value was well above .05 for significance. Even when the LEP CCI scores were correlated to the TTCT-Figural and Verbal scores as bivariate correlations, there was no level of significance. Because of a lack of a strong positive statistically significant correlation between the TTCT and LEP, creativity and cognitive complexity should be treated as separate domains for teaching, developing, learning and evaluating. This finding is discussed in more detail in Chapter 5.

Additional Correlations

Partial Correlations between Creativity, Cognition and Other Variables

Partial correlations describe the linear relationship between two variables while controlling for the effects of another variable. Partial correlations procedure assumes that each pair of variables is bivariate normal. For this reason it was necessary to convert all of the data for the partial correlations to standardized variables; normal scores, z-scores or z-values (Field, 2005). The standard variable is equal to the raw score minus the population mean, divided by the population standard deviation. In cases where it is impossible to measure every member of a population, the standard deviation may be estimated using a random sample (Field, 2005). In addition, since the converted scores were not being compared to the population and just to another set of sample data, it is acceptable to use the sample mean and the sample standard deviation (for large sample sizes) since the purpose was to ensure the data set was normal (Field, 2005). The standard score indicates how many standard deviations an observation is above or below the mean. It allows comparison of observations from different normal distributions.

Creativity, Cognition Controlling for Branch of Service

The second research question was: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and the branch of service (Army, Navy, Air Force, Marines)? There was a small positive correlation, but not statistically significant, between the level of creativity, the level of cognitive development, while controlling for branch of service as seen in Table 4.8 ($r = .109$). To answer this question, the LEP CCI scores and TCTT-Composite scores were correlated, controlling for branch of service of the subject. Therefore the branch of service of an officer does not seem to have an effect on how creative or cognitively complex an officer is. This is discussed in more detail in Chapter 5.

Table 4.8 Partial Correlation between Creativity and Cognition, Controlling for Branch of Service

Control Variables			TTCT average raw score	LEP Scores
Branch of Service	TTCT average raw score	Correlation	1.000	.109
		Significance (2-tailed)	.	.225
		df	0	123
LEP Scores	LEP Scores	Correlation	.109	1.000
		Significance (2-tailed)	.225	.
		df	123	0

Creativity, Cognition Controlling for Combat Experience

The third research question was: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and combat experience? When creativity and cognition were correlated while controlling for combat experience, there was a medium positive correlation ($r = .285, p = .007$). To answer this question the LEP CCI scores and TCTT-Composite scores were correlated while controlling for combat experience (Table 4.9). The experience of combat does seem to have a positive impact on the cognitive complexity and creativity in military officers. This is discussed in more detail in Chapter 5.

Table 4.9 Partial Correlation between Creativity and Cognition, Controlling for Combat

Control Variables			TTCT average raw score	LEP Scores
Combat tour	TTCT average raw score	Correlation	1.000	.285
		Significance (2-tailed)	.	.007
		df	0	87
LEP Scores	LEP Scores	Correlation	.285	1.000
		Significance (2-tailed)	.007	.
		df	87	0

Creativity, Cognition Controlling for Gender

The fourth research question was: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and gender? When creativity and cognition were correlated while controlling for gender, there was a positive correlation, but it was statistically

insignificant ($r = .113$). To answer this question LEP CCI scores and TCTT-Composite scores were correlated while controlling for the gender of the subject (Table 4.10). Because of the small number of females in the sample it may be necessary to survey more females in the future to get a more accurate gage on the effect of gender on creativity and cognition. This is elaborated on in Chapter 5.

Table 4.10 Partial Correlation between Creativity and Cognition, Controlling for Gender

Control Variables			TTCT average raw score	LEP Scores
Gender of subject	TTCT average raw score	Correlation	1.000	.113
		Significance (2-tailed)	.	.208
		df	0	123
LEP Scores		Correlation	.113	1.000
		Significance (2-tailed)	.208	.
		df	123	0

Creativity, Cognition Controlling for Education Level

The fifth research question was: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and education level (bachelor’s, master’s or doctorate)? When creativity and cognition were correlated while controlling for the civilian education level, there was a slight negative correlation; however, it was statistically insignificant ($r = -.045$). To answer this question, LEP CCI scores and TCTT-Composite scores were correlated while controlling for the civilian education level of the subject (Table 4.11). Based on the weak negative correlation when controlling for the effect of education level, it does not seem that the variable of education level influences the creativity and cognition of a military officer very much; however, in Chapter 5 this point is elaborated.

Table 4.11 Partial Correlation between Creativity, Cognition, Controlling for Level of Civilian Education

Control Variables			TTCT average raw score	LEP Scores
Civilian Education Level	TTCT average raw score	Correlation	1.000	-.045
		Significance (2-tailed)	.	.619
		df	0	123
LEP Scores	LEP Scores	Correlation	-.045	1.000
		Significance (2-tailed)	.619	.
		df	123	0

Creativity, Cognition Controlling for Age

The sixth research question was: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and age? When creativity and cognition were correlated while controlling for age, there was a slight positive correlation, but it was statistically insignificant ($r = .111$). To answer this question, the LEP CCI scores and TCTT-Composite scores were correlated while controlling for the age of the subject (Table 4.12). Although there was a moderate positive correlation when controlling for age, it does not appear that this variable has much effect of the creativity and cognition of a military officer. One possible explanation is that there was not much variance in the ages of the officers surveyed; however, Chapter 5 goes into more detail on this finding.

Table 4.12 Partial Correlation between Creativity, Cognition, Controlling for Age

Control Variables			TTCT average raw score	LEP Scores
Age of subject	TTCT average raw score	Correlation	1.000	.111
		Significance (2-tailed)	.	.217
		df	0	123
LEP Scores	LEP Scores	Correlation	.111	1.000
		Significance (2-tailed)	.217	.
		df	123	0

Creativity, Cognition Controlling for Military Rank

When creativity and cognition were correlated while controlling for military rank, there was a slight positive correlation but it was statistically insignificant ($r = .065$). To answer this question, the LEP CCI scores and TCTT-Composite scores were correlated while controlling for the military rank of the subject (Table 4.13). Based on the slight positive correlation between creativity, cognition and military rank, it doesn't seem that rank has much to do with measured levels of creativity and cognition. One possible explanation could be that only two military ranks were surveyed, O-4s and O-5s, and perhaps the difference between those two groups is not all that significant, but maybe the difference between O-3s and O-5s is significant. Chapter 5 goes into more detail on this research question.

Table 4.13 Partial Correlation between Creativity, Cognition, Controlling for Military Rank

Control Variables			TTCT average raw score	LEP Scores
Military Rank	TTCT average raw score	Correlation	1.000	.065
		Significance (2-tailed)	.	.471
		df	0	123
LEP Scores	LEP Scores	Correlation	.065	1.000
		Significance (2-tailed)	.471	.
		df	123	0

Bivariate Correlations Relevant to Creativity and Cognition

Creativity, Cognition and Branch of Service

The second research question was: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and the branch of service (Army, Navy, Air Force, Marines)? There was a small negative correlation, but not statistically significant, between the level of creativity, the level of cognitive complexity, and branch of service, as seen in Table 4.8 ($\tau = -.005$, for LEP and $\tau = -.074$). To answer this question, the LEP CCI scores and TCTT-Composite scores were correlated to the branch of service of the subject (Table 4.14).

Table 4.14 Bivariate Correlations between Creativity and Cognition, and Branch of Service

			Branch of Service	TTCT average raw score	LEP Scores
Kendall's tau_b	Branch of Service	Correlation Coefficient	1.000	-.074	-.005
		Sig. (2-tailed)	.	.280	.944
		N	126	126	126
	TTCT average raw score	Correlation Coefficient	-.074	1.000	.083
		Sig. (2-tailed)	.280	.	.177
		N	126	126	126
	LEP Scores	Correlation Coefficient	-.005	.083	1.000
		Sig. (2-tailed)	.944	.177	.
		N	126	126	126

Creativity, Cognition and Combat Experience

The third research question was: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and combat experience? When combat experience was correlated to the LEP CCI scores (cognition), there was a small positive correlation ($\tau = .246, p = .002$). There was not a significant correlation between combat experience and TCTT-Composite (creativity) scores ($\tau = .059$). To answer this question, the LEP CCI scores and TCTT-Composite scores were correlated to whether the subject had combat experience (Table 4.15). Based on these two correlations, it seems that combat experience seems to have an impact on the level of cognitive complexity, but not on the level of creativity. Therefore, when we noticed in the correlation where the researcher compared the LEP CCI scores with the TTCT scores and there was a correlation of $\tau = .285, p = .007$, what combat experience was really accounting for the greatest amount of variance in the LEP CCI scores as opposed to the TTCT creativity scores. Chapter 5 discusses this in more detail.

Table 4.15 Bivariate Correlations between Creativity and Cognition, and Combat

			TTCT average raw score	LEP Scores	Length of combat tour
Kendall's tau_b	TTCT average raw score	Correlation Coefficient	1.000	.083	.059
		Sig. (2-tailed)	.	.177	.460
		N	126	126	90
	LEP Scores	Correlation Coefficient	.083	1.000	.246(**)
		Sig. (2-tailed)	.177	.	.002
		N	126	126	90
	Combat tour	Correlation Coefficient	.059	.246(**)	1.000
		Sig. (2-tailed)	.460	.002	.
		N	90	90	90

** Correlation is significant at the 0.01 level (2-tailed).

Creativity, Cognition and Gender

The fourth research question was: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and gender? When gender was correlated to the TCTT-Composite scores (creativity), there was a small positive correlation for females ($\tau = .151$, $p = .041$). Does this mean that female field grade officers are generally more creative than male field grade officers? This is discussed more in Chapter 5. There was no significant correlation between males and creativity. There was not a significant correlation between gender and LEP CCI (cognition) scores ($\tau = -.027$). To answer this question, LEP CCI scores and TCTT-Composite scores were correlated to the gender of the subject (Table 4.16).

Table 4.16 Bivariate Correlations between Creativity and Cognition, and Gender

			TTCT average raw score	LEP Scores	Gender of subject
Kendall's tau_b	TTCT average raw score	Correlation Coefficient	1.000	.083	.151(*)
		Sig. (2-tailed)	.	.177	.041
		N	126	126	126
	LEP Scores	Correlation Coefficient	.083	1.000	-.027
		Sig. (2-tailed)	.177	.	.718
		N	126	126	126
	Gender of subject	Correlation Coefficient	.151(*)	-.027	1.000
		Sig. (2-tailed)	.041	.718	.
		N	126	126	126

* Correlation is significant at the 0.05 level (2-tailed).

Creativity, Cognition and Education Level

The fifth research question was: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and education level (bachelor’s, master’s or doctorate)? When the level of civilian education was correlated to the TTCT-Composite scores (creativity), there was a medium positive correlation, as seen in Table 4.11 ($\tau = .341, p < .001$). There was also a medium positive correlation between level of civilian education and LEP CCI (cognition) scores ($\tau = .345, p < .001$). To answer this question, LEP CCI scores and TCTT-Composite scores were correlated to the civilian education level of the subject (Table 4.17). Civilian education does correlate with the TTCT scores and with the LEP scores, but in different ways. This is discussed more in Chapter 5.

Table 4.17 Bivariate Correlations between Creativity, Cognition, and Level of Education

			LEP Scores	TTCT average raw score	Civilian Education Level
Kendall's tau_b	LEP Scores	Correlation Coefficient	1.000	.083	.345(**)
		Sig. (2-tailed)	.	.177	.000
		N	126	126	126
	TTCT average raw score	Correlation Coefficient	.083	1.000	.341(**)
		Sig. (2-tailed)	.177	.	.000
		N	126	126	126
	Civilian Education Level	Correlation Coefficient	.345(**)	.341(**)	1.000
		Sig. (2-tailed)	.000	.000	.
		N	126	126	126

** Correlation is significant at the 0.01 level (2-tailed).

Creativity, Cognition and Age

The sixth research question was: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and age? When age was correlated to the TCTT-Composite scores (creativity), there was a weak negative correlation, but statistically not significant ($\tau = -.033$). There was a weak positive correlation, but not statistically significant, between age and LEP CCI (cognition) scores ($\tau = .102$). To answer this question, the LEP CCI scores and TCTT-Composite scores were correlated to the age of the subject (Table 4.18).

Table 4.18 Bivariate Correlations between Creativity, Cognition, and Age

			TTCT average raw score	LEP Scores	Age of subject
Kendall's tau_b	TTCT average raw score	Correlation Coefficient	1.000	.083	-.033
		Sig. (2-tailed)	.	.177	.609
		N	126	126	126
	LEP Scores	Correlation Coefficient	.083	1.000	.102
		Sig. (2-tailed)	.177	.	.109
		N	126	126	126
	Age of subject	Correlation Coefficient	-.033	.102	1.000
		Sig. (2-tailed)	.609	.109	.
		N	126	126	126

Creativity, Cognition and Military Rank

When the military rank was correlated to the TCTT-Composite scores (creativity), there was a small positive correlation that was statistically significant, as seen in Table 4.13 ($\tau = .15$, $p = .042$). Are O-5s more creative than O-4s? There was also a small positive correlation between military rank and LEP CCI (cognition) scores that was statistically significant ($\tau = .228$, $p = .002$). Do O-5s think at a greater level of cognitive complexity than O-4s? To answer this question, the LEP CCI scores and TCTT-Composite scores were correlated to the military rank of the subject (Table 4.19). These results are discussed in more detail in Chapter 5.

Table 4.19 Bivariate Correlations between Creativity, Cognition, and Military Rank

			LEP Scores	TTCT average raw score	Military Rank
Kendall's tau_b	LEP Scores	Correlation Coefficient	1.000	.083	.228(**)
		Sig. (2-tailed)	.	.177	.002
		N	126	126	126
	TTCT average raw score	Correlation Coefficient	.083	1.000	.150(*)
		Sig. (2-tailed)	.177	.	.042
		N	126	126	126
	Military Rank	Correlation Coefficient	.228(**)	.150(*)	1.000
		Sig. (2-tailed)	.002	.042	.
		N	126	126	126

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Other Correlations not Involving Creativity or Cognition

When all of the bivariate correlations were conducted between each of the variables, there were other statistically significant correlations found. These other correlations between the variables were related to neither creativity scores on the TTCTs nor CCI scores on the LEP.

Age, Combat Experience and Education Level

There is a medium positive correlation between combat experience and age, as seen in Table 4.20 ($\tau = .465, p < .001$). While at face value this may seem intuitive, this does suggest that older officers are serving more time in combat, specifically in Iraq and Afghanistan. For all of the officers between the ages of 40 and 44, the average amount of combat experience was 17 months. For all of the officers between the ages of 34 and 39, the average amount of combat experience was 11 months. The entire population surveyed at JCWS had been serving in the military since combat operations began for Operation Enduring Freedom (OEF) in Afghanistan in October 2001 and Operation Iraqi Freedom (OIF) in April 2003: the number of officers who had combat experience before OEF and OIF (i.e., Operation Just Cause in 1989 or Desert Storm in 1991) is relatively small, only 6 officers. When these officers were removed from the sample, the average amount of combat experience for 40- to 44-year-old officers dropped to 15 months, and for officers between the ages of 34 to 39, the amount of combat experience dropped to 10 months. This still suggested that older officers spent more time in the combat zone.

Table 4.20 Bivariate Correlation between Age and Combat Experience

			Age of subject	Combat tour
Kendall's tau_b	Age of subject	Correlation Coefficient	1.000	.465(**)
		Sig. (2-tailed)	.	.000
		N	126	90
	Combat tour	Correlation Coefficient	.465(**)	1.000
		Sig. (2-tailed)	.000	.
		N	90	90

** Correlation is significant at the 0.01 level (2-tailed).

In addition to the strong correlation between age combat experience, age is also moderately positively correlated to civilian education level ($\tau = .161, p < .05$). This is also

intuitive, as age has allowed officers more time and opportunities to achieve more civilian education. All of the doctorate degrees were held by officers above the age of 40.

Branch of Service and Length of Combat Tour

There was a medium negative correlation between branch of service and length of combat tour, as seen in Table 4.21 ($\tau = -.336, p < .001$). The reason for the negative correlation between branch of service and length of combat tour arose from the branches assigned as nominal data within the SPSS program. When the branch of service was compared to average length of the combat tour, there was an obvious difference between the branches. When the average length of combat tour was calculated, officers who had not served in combat were calculated as serving 0 months as a combat tour. The Army officers had the longest average length of combat tour at 17.1 months, followed by the Air Force at 14.6 months, then the Navy at 12.4 months, and the Marines at 9 months in combat.

Table 4.21 Bivariate Correlation between Branch of Service and Length of Combat Tour

			Branch of Service	Length of combat tour
Kendall's tau_b	Branch of Service	Correlation Coefficient	1.000	-.336(**)
		Sig. (2-tailed)	.	.000
		N	126	90
	Length of combat tour	Correlation Coefficient	-.336(**)	1.000
		Sig. (2-tailed)	.000	.
		N	90	90

* Correlation is significant at the 0.01 level (2-tailed).

Branch of Service and Civilian Education Level

There was a small positive correlation between branch of service and level of civilian education achieved, as seen in Table 4.22 ($\tau = .179, p = .027$). When the data were examined, it was found that all of the Air Force officers had at least a master's degree ($n = 44$), with two officers with doctorates. The Army accounted for all but two of the doctorate degrees ($n = 6$), but also accounted for all of the officers who only had bachelor's degrees ($n = 11$). All of the other army officers held master's degrees ($n = 16$). All of the Navy officers ($n = 35$) and Marine officers ($n = 12$) surveyed held master's degrees.

Table 4.22 Bivariate Correlation between Branch of Service and Civilian Education Level

			Branch of Service	Civilian Education Level
Kendall's tau_b	Branch of Service	Correlation Coefficient	1.000	.179(*)
		Sig. (2-tailed)	.	.027
		N	126	126
	Civilian Education Level	Correlation Coefficient	.179(*)	1.000
		Sig. (2-tailed)	.027	.
		N	126	126

* Correlation is significant at the 0.05 level (2-tailed).

Summary of Research Findings

In this chapter, the demographic data on the sample population and correlation data were reported. There was a sample of 126 students surveyed out of a population of 250 students at JCWS in class 08-02. The mean age of the officer surveyed was 39.5. Males accounted for 89% of the sample population. Officers surveyed who had combat experience numbered 76.2%. There was almost an equal split between O-4s (47.6%) and O-5s (52.4%). In educational degrees, 10% of the sample population held bachelor degrees, 83% held master degrees, and 7% held doctorates. Army and Air Force officers each accounted for 33.3% of the sample population, while Navy officers accounted for 23.8% and Marine officers for 9.5%.

When the LEP CCI scores were examined, it was found that the mean score was 391, which roughly corresponds to a Perry position 4 on the LEP. Given the average level of education and the average age of the officers surveyed, the mean LEP CCI score was as expected.

When the TTCT scores were examined, the mean score for the Figural test was at the 47th percentile and the mean score for the Verbal test was at the 67th percentile. The Figural mean score was marginally below the 50th percentile, while the Verbal scores were moderately above the 50th percentile. The TTCT-Composite mean score was at the 57th percentile, which was slightly above average.

The following questions were answered by this research data:

1. What is the nature of the correlation between the level of cognitive development and the level of creativity in field grade officers at the Joint and Combined

Warfighter School? (Primary Research Question) There was an insignificant positive correlation between the measured levels of cognitive complexity (LEP CCI) and the measured level of creativity (TCTT-Composite) in field grade officers at the Joint and Combined Warfighter School ($\tau = .083$).

2. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and the branch of service (Army, Navy, Air Force, Marines)? (secondary research question) There was an insignificant positive correlation between the level of creativity and the level of cognitive development, while controlling for branch of service ($\tau = .109$). There was an insignificant negative correlation between the level of creativity, the level of cognitive development, and branch of service ($\tau = -.029$ for LEP CCI, and $\tau = -.108$ for TTCT).
3. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and combat experience? (secondary research question) When creativity and cognition were correlated while controlling for combat experience, there was a small positive correlation ($\tau = .285, p = .007$). When combat experience was correlated to the LEP CCI scores (cognition), there was a small positive correlation ($\tau = .246, p = .002$). There was not a significant correlation between combat experience and TCTT-Composite (creativity) scores ($\tau = .059$).
4. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and gender? (secondary research question) When creativity and cognition were correlated while controlling for gender, there was a positive correlation, but it was statistically insignificant ($\tau = .113$). When gender was correlated to the TCTT-Composite scores (creativity) there was a small positive correlation for females ($\tau = .151, p = .041$). There was no significant correlation between gender and LEP CCI (cognition) scores ($\tau = -.027$).
5. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and education level (bachelor's, master's or doctorate)? (secondary research question) When creativity and cognition were correlated while controlling for the civilian education level, there was an insignificant

negative correlation ($\tau = -.045$). When the level of civilian education was correlated to the TCTT-Composite scores (creativity), there was a medium positive correlation ($\tau = .341, p < .001$). There was also a medium positive correlation between level of civilian education and LEP CCI (cognition) scores ($\tau = .345, p < .001$).

6. What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and age? (secondary research question) When creativity and cognition were correlated while controlling for age, there was an insignificant positive correlation ($r = .111$). When age was correlated to the TCTT-Composite scores (creativity), there was an insignificant negative correlation ($\tau = -.033$). There was an insignificant positive correlation between age and LEP CCI (cognition) scores ($\tau = .102$).

Through the examination of the interaction of the other observed variables, more statistically significant correlations were found. There was a medium positive correlation between combat experience and age ($\tau = .465, p < .001$). Age was also moderately positively correlated to civilian education level ($\tau = .161, p < .05$). There was a medium negative correlation between branch of service and length of combat tour ($\tau = -.336, p < .01$; the Army serves more time in combat, the Navy the least amount of time). The average length of combat tour for Army officers was 17.1 months, which was greater than the other three branches. There was a small positive correlation between branch of service and level of civilian education achieved ($\tau = .179, p = .027$). The Air Force was the most educated, followed by the Navy and Marines, followed by the Army; the Army having the most doctorates but even more soldiers with only bachelor's degrees.

A discussion, conclusions, and recommendations based on these findings follow in Chapter V.

CHAPTER 5 - Summary and Discussion

Overview

The final chapter of this research about the nature of the association between cognitive complexity and creativity in field grade officers in the military includes a restatement of the problem, a review of the research methods, and discussion of the findings and conclusions. Also discussed are implications for further research and applications of this research for the military.

Limitations of the Study

As an exploratory study, this research had some inherent limitations, many of which will be addressed in future research. The following limitations applied to this research:

1. The results are not generalizable.
2. The results of this study are exploratory.
3. The results of this study are limited by the accuracy and the truthfulness of the participants' self-reported data.
4. The results of this study are limited by the features of the LEP and the TTCT instruments.
5. The results do not show causality, but rather a relationship between variables.
6. The results are bound by the definitions that were used to explain cognitive complexity (from the LEP; Moore, 1989) and creativity (from the TTCT; Torrance, 1974).

Restatement of Problem

Although independent research on cognitive complexity and creativity exists, little research is prevalent that investigates the nature of the correlation between creativity and cognition. While scientists acknowledge the existence of some sort of relationship (i.e., Carson, 2003; Finke, Ward & Smith, 1996), explaining the nature of the correlation as a relationship between the two is not ubiquitous. This research was conducted with a sample of military officers attending the Joint and Combined Warfighter School in Norfolk, VA, from 14 January to 21 March 2008.

The Secretary of Defense, Robert M. Gates, asked military officers to “become forward thinkers with courage to advance new approaches needed to confront current and emerging threats” (Miles, 2008, p.A3). Gates challenged officers to “think outside the box to help the military to adapt to a constantly changing strategic environment” (Miles, 2008, p.A3). The Secretary of Defense recognized that creativity and cognitive complexity are important qualities for officers to have in order to solve the current and future problems the military will face.

By grouping blocks of instruction on cognitive complexity and creativity at military schools, such as the Army’s Command and General Staff School, the Air Force’s Air Command and Staff School, and the Joint Forces Command’s Joint and Combined Warfighter School, there was an underlying assumption that these two concepts are related. The Department of Defense attempts to train soldiers to function in ambiguous environments and expects its officers to be creative in their approaches to planning and problem solving (Clark, 2006; Joint Forces Staff College, 2007). The military stated that it needs soldiers who have the ability to think at a complex level and are creative, so it wanted to improve creativity and cognitive thinking ability in its officer corps (U.S. Department of Defense, 2006). Even Secretary Gates when referring to the military’s academic halls stated that “virtually every institution is organized in a way to stifle out-of-the-box thinking,” understood that this is an issue that needs to be confronted (Miles, 2008, p.A3). This research specifically investigated the level of cognitive complexity using the LEP CCI and the level of creativity using the TTCT and analyzed the correlations to determine whether there was a relationship between the two.

Review of Research Methods

This was a quantitative study that used a non-experimental, correlational design (Campbell & Cook, 1979; Campbell & Stanley, 1963; Patton, 2002). This research design was to explore the relationship that occurs between the level of cognitive development and the level of creativity, and how the covariates of branch of service, gender, combat experience, age, and education level affect that correlation (see Appendixes A, B, and H). This study described the relationship between the level of cognitive complexity by using the Learning Environments Preference (LEP) instrument and level of creativity by using the Torrance Tests of Creative Thinking (TTCT-Verbal and Figural), and analyzed how the variables of branch of service, age, rank, gender, combat experience, and education level effect that correlation.

Correlational studies are used to look for relationships between variables: in this study the level of cognitive complexity and level of creativity of subjects (Field, 2005). No correlation between cognitive complexity and creativity was found in this study. There were three possible results: a positive correlation, a negative correlation, or no correlation. A positive correlation would indicate that as cognitive complexity increases, so would creativity, and vice versa. A correlation coefficient approaching +1.00 indicates a strong positive correlation. An example of a negative correlation would be if there was a high level of cognitive complexity and a conversely low level of creativity. A correlation coefficient that approaches -1.00 would indicate a strong negative correlation. If the correlation coefficient was close to 0, then it would be a sign of no relationship between the two variables measured (Field, 2005). This study found that the correlation between cognitive complexity and creativity was $\tau = .083$, which indicated no significant relationship.

The survey instruments were administered by the researcher to 126 students attending the Joint and Combined Warfighter School. The LEP instrument was scored by the Center for the Study of Intellectual Development and the TTCT instruments were scored by the Scholastic Testing Service. The researcher correlated the Figural and Verbal scores on the TTCT using the Kendall's Tau statistic and found that these scores had an extremely high level of positive correlation ($\tau = .723, p < .001$). The individual TTCT-Figural and Verbal raw test scores were then averaged for each subject to generate one TTCT-Composite score for creativity. The LEP CCI and the TTCT-Composite scores were then correlated using the Kendall's Tau *b* statistic.

The researcher then conducted partial correlations where the variables of branch of military service, combat experience, gender, civilian education level, and age were analyzed. Each of the aforementioned variables were controlled for in the partial correlation between creativity and cognitive complexity. The effect of branch of service, combat experience, gender, education level and age were measured. After the partial correlations were conducted, creativity was correlated bivariately correlated to branch of service, combat experience, gender, education level and age, after which cognitive complexity was bivariately correlated to all of the other variables. Significant and noteworthy correlations were recorded and are discussed in this chapter.

Discussion of Findings and Conclusions

The research tested a sample of field grade officers on their level of cognitive complexity and creativity, and then determined whether there was a correlation between the two areas.

Research Question 1

Research Question 1: What is the nature of the correlation between the level of cognitive complexity and the level of creativity in field grade officers at the Joint and Combined Warfighter School? (Primary research question)

This research question is significant to the military because of the recognized importance of creativity, adaptability, cognitive development and critical thinking training in the intermediate level education of military officers by the DoD (Clark et.al., 2006). There was an insignificant positive correlation between the measured level of cognitive development on the LEP CCI and the measured level of creativity on the TTCT ($\tau = .083$). This result indicated that there was no significant relationship between creativity and cognitive complexity. This finding is important. It can be concluded that LEP CCI scores had no bearing on TTCT scores, and vice versa. It cannot be said with any certainty that LEP CCI scores do or do not cause any fluctuation in TTCT scores (Field, 2005). It must be stated that these results depended on the definitions that were used to define creativity and cognitive complexity (Moore's definition for cognitive complexity and Torrance's definition for creativity). The results in the research conflicted with some of the other research conducted on cognition and creativity, and the definitions that corresponded to the instruments used in this research could explain this conflict. This finding was contrary to some of the recent neuro-scientific research conducted by Vandervert (2003a, 2003b; Vandervert et al., 2007). These research findings paralleled findings by Gardner, Meneely and Sternberg, in that there are multiple intelligences and many learning domains in the brain (Gardner, 1983; Meneely and Portillo, 2005; Sternberg, Kaufman, and Pretz, 2002).

The research problem and purpose were inspired by curricula at several Department of Defense intermediate level academic institutions (i.e. the Army's Command and General Staff School and the Air Force's Air War College). These institutions, which educate field grade officers in the military, recognized that these officers need training and education that enhanced creativity and inspired development of cognitive complexity. These classes were normally taught within the first 2 months of the 10-month school. They were as a rule taught either in conjunction

with one another or treated as one contiguous block of instruction. The researcher wondered whether this methodology was sound, and furthermore, whether it was effective. From the findings in this research, it can be concluded that treating cognitive complexity and creativity as being correlated was false. By the test scores on the LEP CCI and TTCT, it can be concluded that officers in the military have normal levels of cognitive complexity and creativity. The mean score on the LEP CCI was 391, which corresponds to the score expected from someone with a master's degree (Moore, 1989). The mean scores on the TTCT Figural and Verbal tests placed the sample population in the 47th percentile for figural and 57th percentile for verbal creativity; these are scores that could be expected from a sample of the general, non-military, population (Torrance, 2008d and e). It was not determined whether the curricula at military institutions on cognitive complexity and creativity is effective at improving performance in these domains, which would be a subject for follow-up research, but it was determined that military officers have normal levels of aptitude in these competencies. What this research concluded was that cognitive complexity and creativity should be treated as separate learning areas. Therefore, if cognitive complexity and creativity are separate functions that occur separately and are not related, then academic institutions should think of them as separate (Carson, 2005).

Research Question 2

Research Question 2: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and the branch of service (Army, Navy, Air Force, or Marines)? (Secondary research question) There is an insignificant positive correlation between the aforementioned variables ($r = .109$). There was an insignificant negative correlation between cognitive complexity and branch of service, and creativity and branch of service ($\tau = -.029$ for LEP CCI, and $\tau = -.108$ for TTCT).

The pre-Christian understanding of creativity was originally associated with mystical powers of protection and good fortune and largely reflected a result of cultural perspectives (Albert & Runco, 1999). During these times creativeness took on a social value; a view that reappeared during most of the 19th and first half of the 20th centuries (Galton, 1869). It had to do with the social significance and potential dangers of originality and individualism in the context of compliance to authority and maintenance of social order (Proctor and Burnett, 2004; Albert & Runco, 1999; Galton, 1874, 1869). Military services have cultures. These cultural differences

cause officers of different services to analyze problems in different ways, sometimes due to social pressures and sometimes due to training and conditioning (Johnson, 2003; Pudas, 2003). A submariner in the Navy may be able to generate solutions to a problem that would be unique because of the experiences that are exclusive to submariners. These experiences would be different from those of an infantry platoon leader in the Army or a U-2 pilot in the Air Force. Cultural differences sometimes create biases and prejudices that may unwittingly impact decision making (Kegan, 1982, 1994). While it was evident that the service background of the officer did not seem to have an effect on their creativity and cognitive complexity scores, the military acknowledges cultural differences in its branches (Pukalos, 2000; Joint Forces Staff College, 2007). Stated simply, military culture comprises the ethos and professional attributes, derived from both experience and intellectual study, that contribute to military organizations' core, common understanding of the nature of war. Less easily studied than defined, its influence on military institutions is almost always the result of long-term factors rarely measurable and often obscure both to historians and to those actually serving in the institutions (Ritzer, 2004). Based on the results of the LEP and TTCT test scores, these cultural differences seem to impact neither levels of creativity nor levels of cognitive complexity. The service background of an officer does not seem to have an effect on creativity nor cognitive complexity.

Research Question 3

Research Question 3: What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and combat experience? (Secondary research question) When creativity and cognition were correlated while controlling for combat experience, there was a strong positive correlation ($r = .285, p = .007$). When combat experience was correlated to the LEP CCI scores (cognition), there was a small positive correlation ($\tau = .246, p = .002$). There was no significant correlation between combat experience and TCTT-Composite (creativity) scores ($\tau = .059$).

Combat experiences influence an officer's cognitive complexity. In Gary Klein's *Sources of Power: How People Make Decisions*, (2001) he examined how experience effected decision making. He stated that through experience and especially intense situations of high stress, our decision making abilities improved and became more intuitive. This power of intuition enables us to size up situations more quickly. The power of mental simulation lets us imagine how a

course of action might be carried out. Experienced decision makers are used to making “high staked choices, such as those make in the life and death environment of combat” (Klein, 2001, p.4)

Deployment to a combat zone is an extremely stressful experience. An examination of the psychological effects of combat must begin by acknowledging that there are some positive aspects to the experience (Grossman, 1995, 2004). One positive aspect is that through desensitization to stressful experiences, different parts of the brain are employed; people begin to “start thinking with the front of the brain and stop thinking with the mid-brain” (Grossman, 1995, p. xviii). As soldiers become more familiar with the sensations of combat they are able to regulate their hormonal or fear induced heart rate and the resulting sympathetic nervous system arousal; complex motor skills become enhanced, visual reaction time is increased and cognitive reaction time is increased (Grossman, 2004). Over time, the cognitive thinking skills move from being a non-automated response to an automated response, thus improving reaction time and effectiveness (Grossman, 2004).

Throughout recorded history these positive aspects have been emphasized and exaggerated in order to protect the self-image of combatants, honor the memory of the fallen, and rationalize their deaths, to aggrandize and glorify political leaders and military commanders, and to influence populations into supporting war (Grossman, 1995). The implications of this for understanding environmental influences on creativity and cognition are extremely important (Hunter, Bedell, & Mumford, 2007). However, the fact that these positive aspects have been manipulated and exploited does not deny their existence. There is a reason for the powerful attraction of combat over the centuries, and there is no value in going from the dysfunctional extreme of glorifying war to the equally dysfunctional extreme of denying its attraction. Most observers of combat lump the impact of this physiological arousal process under the general heading of fear, but fear is really a cognitive or emotional label for nonspecific physiological arousal in response to a threat (Grossman, 2004). These responses have a profound effect on learning and the brain, and in turn have a lasting impact on how a person thinks, relates to and responds to the environment.

The extreme stresses of combat seem to have a positive effect on how the mind evaluates things at a cognitive level. Gary Klein hypothesized that while stressors inhibit our chance to gather information, disrupt our ability to use our working memory to sort things out and distract

our attention from the task at hand, there may also be some benefits (2001). The affect of prolonged exposure to stressful situations may result in the creation of recognitional decision strategies, thus you would not see much disruption and degradation in cognitive levels. Combat experiences, according to this research, correlate positively with the cognitive complexity of a person. This discovery was similar to the findings of the 7-year TADMUS (Tactical Decision Making Under Stress) research project (Cannon-Bowers, 2000). Given this, do high stress experiences in general have a positive impact on the cognitive complexity of an individual? This research indicates yes, however, more research might be needed to understand the answer this question.

Research Question 4

What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and gender? (Secondary research question) When creativity and cognition were correlated while controlling for gender, there was an insignificant positive correlation ($r = .113$). However, when gender was correlated to the TCTT-Composite scores (creativity), there was a positive correlation for females ($\tau = .151, p = .041$). There was no significant correlation between gender and LEP CCI (cognition) scores ($\tau = -.027$).

Throughout history there has been a discussion about gender and creativity. The ancient Roman's viewed creativity and the ability to rationally think about problems as completely a capacity that only belonged to males and a power that they could pass on to their sons (Harrison, 2004). This research, and other more extensive research on creativity (i.e. Torrance, 2002), indicated that males are not the only ones that can be creative.

Creativity is a state of being, a way to meet the challenges involved in bringing any project to completion. As researchers studied the nature of creativity, they discovered a very different picture. They have found evidence that creativity is heavily grounded in the individual's knowledge and how a person combines knowledge of dissimilar concepts to create new perspective (Csikszentmihalyi, 1996). Creativity may seem to appear by magic as the pre-Christians believed (Galton, 1869), but in truth it comes from a deep well of information (Csikszentmihalyi, 1996). Often the real challenge is to sort out the irrelevant material from the usable. One must still be open to ideas that seem irrelevant and yet may be just the piece needed for the desired result. Officers need a deep understanding of their craft, as well as refined skills,

in order to expand their creativity (Sternberg, 2007). Without general knowledge they cannot draw from their memories to find unique and interesting ideas or concepts to pull together (Csikszentmihalyi, 1996). Another reason that officers want their skills to become a part of them is that then they are free to concentrate on creative aspects (Csikszentmihalyi, 1996). It is vital that officers continue to grow in their field in order to thrive in it. Of course, the more that is learned, the more there is to remember. If skills are used on a regular basis, they become almost automatic and can be drawn from whenever needed (Vandervert, 2003a). For example, those who frequently write haiku won't have to look up the rules for its structure. Those who frequently use a certain function of military gear will not need the manual. It is important that officers practice those skills they want to develop (Clark et. al., 2006).

Another important aspect of Torrance's Tests of Creative Thinking is that studies have shown them to have no gender or age bias of any sort (Torrance, 2008a, 2008c). If this is true, then female field grade officers might be unique with respect to their level of creativity. Almost as compelling as identifying this elevated level of creativity in females in the military, might be answering the question of why this exists.

Due to the small number of females in the sample, all of this could be explained by the Law of Large Numbers (Field, 2005). In this theorem the probability is that the long-term stability of a random variable exists with the more samples that are taken. Given a sample of independent and identically distributed random variables with a finite expected value, the average of these observations will eventually approach and stay close to the expected value. Therefore, this result could be explained away by sampling more females from this population.

The question remains of why females in the sample were more creative than were the males. Since women in the military are operating in a male-dominated environment, is it that females must rely on understanding doctrine, their experiences, and competence in order to compete with males? Perhaps it has to do with the social significance and potential dangers of originality and individualism in the context of compliance to authority and maintenance of social order (Albert & Runco, 1999; Galton, 1874, 1869). From a social psychology perspective, Teresa Amabile presents her social psychological perspective on creativity that could be gender related in the military. In her work, Amabile presented a comprehensive picture of how the motivation for creative behavior, and creativity itself, can be influenced by the social environment (1996). In *Woman's Ways of Knowing: The Development of Self, Voice, and Mind*, Mary Field Belenky,

Blythe McVicker Clinchy, Nancy Rule Goldberger, and Jill Mattuck Tarule (Belenky et. al., 1997) presented their theory on the cognitive complexity of women, contrasting it with the patterns found in males, as a woman's way of knowing. Perhaps it is this different way of knowing that leads to the improved domain of creativity of females in this sample, or is it a greater understanding of the profession that leads to a female's increased creativity in the military?

Research Question 5

What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and education level (bachelor's, master's or doctorate)? (Secondary research question) When creativity and cognition were correlated while controlling for the civilian education level, there was an insignificant negative correlation ($r = -.045$). When the level of civilian education was correlated to the TCTT-Composite scores (creativity), there was a medium positive correlation ($\tau = .341, p < .001$). There was also a medium positive correlation between level of civilian education and LEP CCI (cognition) scores ($\tau = .345, p < .001$).

Dr. Gerard Puccio, from Buffalo State University, who co-authored *Creative Leadership: Skills that Drive Change*, with Mary Murdock and Marie Mance, believed that creativity could be taught and in the importance of creativity education (2007), so much so that Buffalo State University offers not only a Bachelor's degree, but a Master's degree in creative studies. Mark Runco also believed in the importance of education and in the education of creativity. Runco codified the field by making creativity a class that can be taught from a textbook that is laid out in his textbook, *Creativity: Theories and Themes: Research, Development, and Practice* (2007).

J. P. Guilford (1950) asked in his inaugural address to the American Psychological Association why schools were not producing more creative persons. He also asked, "Why is there so little apparent correlation between education and creative productiveness?" (p.444). One of the purposes of this study was to develop a deeper understanding of how education impacted (i.e. helped or hindered) the creativity of officers in the military. Creativity and education may have been disconnected topics in a scholarly sense, primarily because (a) education has relied primarily on theory as a guide to practice; (b) psychometric research on creativity proved conceptually and methodologically difficult, short-circuiting widespread use of creativity tests; and (c) contemporary approaches to creativity tended to be either broadly theoretical or primarily

concerned with answering basic research questions. For these reasons, little research explored the connection between education and creativity. Theorists postulated that there is a connection between expertise and creativity (Csikszentmihalyi, 1996). Researchers like Belenky et al., Baxter Magolda, and Moore looked at the connection between cognitive complexity and education, so to see this correlation appear in this research was not as surprising as the connection between creativity and education (Baxter Magolda, 1992; Belenky, 1997; Moore, 1989). That being said, there does appear to be a strong connection between cognitive complexity and education, as Moore found in his research (1989), and there appears to be a strong connection between creativity and education (King and Kitchener, 1994). More research is needed to understand the nature of these correlations, especially the correlation between creativity and education.

Research Question 6

What is the nature of the correlation between the level of creativity, the level of cognitive complexity, and age? (Secondary research question) When creativity and cognition were correlated while controlling for age, there was an insignificant positive correlation ($r = .111$). When age was correlated to the TCTT-Composite scores (creativity), there was an insignificant negative correlation ($\tau = -.033$). There was an insignificant positive correlation between age and LEP CCI (cognition) scores ($\tau = .102$).

Since there was a correlation between creativity, cognition, and education, one might expect that there would be a positive correlation between creativity, cognition and age; this was not the case. As a matter of fact, there was a slight negative correlation between creativity and age. This was contrary to the study by Wu, Cheng, Ip, and McBride-Chang (2005) that explored performances on three types of creativity tasks: real-world problem, figural, and verbal (Torrance, 1974) and compared results between grade school children and adults. They found that age made a difference. However, in this study there was only a slight positive correlation between cognition and age. This later finding was in contrast to Moore's finding in which cognitive complexity improved with age (1989). Some theorists might explain the negative correlation between creativity and age by saying that as people age, they rely on crystallized intelligence. Neuroscience might explain that the reason is degradation in the medial lobes, which is the part of the brain that helps to recall experiences (Vandervert, 2007). Cognitive

psychologists might explain the positive correlation between age and cognitive complexity saying that it would be expected (Perry, 1970). Fluid intelligence, like reaction time, peaks in young adulthood and then steadily declines (Vandervert et al., 2007). This decline is possibly due to local atrophy of the brain in the right cerebellum (Lee, et al., 2005). Cavanaugh and Blanchard-Fields (2006) also indicate that a lack of practice, along with the age-related change in the brain may contribute to the decline. Crystallized intelligence increases gradually, then stays relatively stable across most of adulthood, and begins to decline after age 65 (Cavanaugh & Blanchard-Fields, 2006). A few other reasons could explain this. The ages of the subjects only ranged from 34 to 44, with a mean age of 39.5. The small range in the ages could explain only the slight correlations. Regardless, according to the results of this study, there does not appear to be a correlation between age and the aptitudes of creativity and cognition for military field grade officers.

Additional Correlations

There was a small positive but not statistically significant correlation between the level of creativity, the level of cognitive development, and military rank ($r = .065$). To answer this question, the LEP CCI scores and TCTT-Composite scores were correlated to the military rank of the subject. Similar to the correlation of age, there was not a great range of ranks; only O-4 and O-5. If a greater range of ranks were surveyed perhaps a larger correlation would have been found. This could be one plausible explanation for the lack of a correlation. More research may be needed to determine the true nature of this correlation, or lack there of. However, when the military rank was correlated to the TCTT-Composite scores (creativity), there was a moderate positive correlation that was statistically significant, as seen in ($\tau = .15, p = .042$). There was also a small positive correlation between military rank and LEP CCI (cognition) scores that was statistically significant ($\tau = .228, p = .002$). The bivariate correlations between both creativity and rank and cognition and rank produced positive correlations.

The first question the researcher must answer was why would there be strong positive bivariate correlations and not a partial correlation? Since there is not a strong correlation between cognition and creativity to begin with, one would not expect that there would be a partial correlation with another variable (unless, of course, the researcher was able to identify the variable that would be responsible for affecting the variables of creativity and cognition to

correlate). Therefore, the conclusion that the researcher made was that rank must not be the variable that would correlate the two variables of creativity and cognition. Rank did, however, correlate directly with creativity and cognition individually. Since military rank is a function of expertise, competence, and experience, one can conclude that expertise, competence, and experience might be positive influences on creativity and cognition. More research is needed to support this assumption.

When all of the bivariate correlations were conducted between each of the variables, there were other statistically significant correlations found. These other correlations between the variables were not related to either creativity scores on the TTCT or the CCI scores on the LEP.

There is a medium positive correlation between combat experience and age ($\tau = .465, p < .001$). While at face value this may seem intuitive, this suggested that older officers served more time in combat, specifically in Iraq and Afghanistan. For officers between the ages of 40 and 44, the average amount of combat experience was 17 months. For officers between the ages of 34 and 39, the average amount of combat experience was 11 months. The entire population surveyed at the Joint and Combined Warfighter School has been in the military since combat operations began for Operation Enduring Freedom (OEF) in Afghanistan in October 2001 and Operation Iraqi Freedom (OIF) in April 2003: the number of officers who had combat experience before OEF and OIF (i.e. Operation Just Cause in 1989 or Desert Storm in 1991) was relatively small, only 6 officers. When these officers were removed the sample of officers surveyed, the average amount of combat experience for 40- to 44-year-old officers dropped to 15 months, and for officers between the ages of 34 to 39, the amount of combat experience dropped to 10 months. This suggested that older officers spent more recent (2001 and forward) time in the combat zone. There might be some long-term effects of this phenomenon. Normally, older officers have developed coping mechanisms to help reduce the stress that combat places on an individual, but that amount of stress has long-term effects on the physical health of individuals (Grossman, 2004). A longitudinal study on the effect of combat stress on health and age would provide insight.

In addition to the strong correlation between age and combat experience, age is also moderately positively correlated to civilian education level ($\tau = .161, p < .05$). This was also insightful, as greater age allowed officers more time and greater opportunities to achieve more civilian education. All of the doctorate degrees were held by officers above the age of 40.

There was a medium negative correlation between branch of service and length of combat tour, as seen in Table 4.15 ($\tau = -.336, p < .01$). The reason for the negative correlation between branch of service and length of combat tour arose from how the branches were assigned as nominal data within the SPSS program. When the branch of service was compared to average length of the combat tour, there was an obvious difference between the branches. When the average length of combat tour was calculated, officers who had not served in combat were calculated as serving 0 months as a combat tour. The Army officers had the longest average length of combat tour at 17.1 months, followed by the Air Force at 14.6 months, then the Navy at 12.4 months, and the Marines at 9 months in combat. This data was only based off of this survey and does not reflect the actual average deployment times for officers from those branches of service.

There was a small positive correlation between branch of service and level of civilian education achieved ($\tau = .179, p = .027$). When the data were examined, it was found that all of the Air Force officers had at least a master's degree ($n = 44$) with two officers with doctorates. The Army accounted for all but two of the doctorate degrees ($n = 6$), but also accounted for all of the officers who only had bachelor degrees ($n = 11$); all of the other army officers held master's degrees ($n = 16$). All of the Navy officers ($n = 35$) and Marine officers ($n = 12$) surveyed held master's degrees. Therefore, to rank the services on which was most to least educated, the Air Force was most educated, the Navy and Marines tied, and the Army was the least educated. A closer examination of the data indicated that there were not enough data points to state with any degree of certainty that this was a true reflection of the education levels of field grade officers in the military. Using the Table of "Recommended Sample Sizes (n) for Populations (N)," a necessary sample size would be closer to 400, rather than 126 (Krejcie & Morgan, 1970, p. 610). In addition, since all of the officers surveyed had attended an intermediate level education institution (i.e., Army Command and General Staff School or Air Force Command and Staff School, Marine Staff College and Naval War College), it must be noted that the Air Force, the Navy, and the Marine Corps all grant master's degrees to the graduates of their respective intermediate level education institutions, while the Army does not. This might explain why some Army officers still have only bachelor degrees.

Implications of Results

This research was conducted to gain a greater understanding of the connection between creativity and cognitive complexity in order to help the development of curriculum for the enhancement of cognitive complexity and creativity. The Department of Defense recognizes that creativity and cognitive complexity are important, and therefore tries to enhance these capabilities through education. This research is noteworthy from the standpoint that the military considers cognitive development and creativity to be two characteristics of higher order thinking that are important to performing and excelling in ambiguity in the contemporary operating environment (Clark, Cracraft, & Ferro, 2006). There is a shortage of research examining cognitive development with creativity, so this research adds to that study (Finke et al., 1996). Intermediate level academic institutions such as the Army's Command and General Staff School attempt to improve its students' levels of creativity and cognitive complexity and should use studies such as this one to guide the development of their curriculum to support student terminal learning objectives (Command and General Staff College campaign plan, 2005). In addition, there is little scientific evidence to suggest that there is a correlation between creativity and cognitive complexity, so this study contributes to that body of knowledge. Therefore, this exploratory study that shows a lack of relationship between the measured levels of cognitive complexity and the measured levels of creativity is an important first step in understanding how to improve the creativity and cognitive complexity of students at academic institutions.

Practice Implications

Writers have offered a variety of recommendations for how to stimulate creative thinking. For example, in attempting to come up with new ideas, a person should strive to be original, take a problem-finding attitude, strive for objectivity, strive for quality, notice new possibilities, change the problem when one gets stuck, make one's thoughts concrete, focus on particular contexts, and consider unusual objects or possibilities (Clark et al., 2006). Others have made numerous practical recommendations for how to generate creative ideas and solutions to problems. The researcher recommends that a person who wants to become more creative should practice generating pre-inventive structures and explore novel interpretations of them (Finke, 1996). For example, one might imagine pre-inventive object forms such as innovations for the combat boot, and then consider various ways in which the forms could be seen as representing

new types of solutions to problems or potential new concepts. Similarly, one could imagine putting together words or phrases in interesting combinations – such as considering a new acronym for a new piece of equipment, as the military is prone to do, i.e., the “Hummer” - and then explore some of their semantic or metaphorical implications.

Often an idea may inspire a variety of new insights. Recording pre-inventive ideas provides extended opportunities to explore the creative possibilities that they might afford. Another recommendation is to practice imagining creative exemplars that pertain to hypothetical categories or situations and then exploring their implications. For example, imagine how people might behave differently if the world were suddenly changed in certain respects. If gasoline did not exist, how would this affect the way we live? If ears had not evolved, how would the human sensory system be different?

Create Attitudes Conducive to Creativity

In considering the most important attitudes to possess when trying to be creative, referring to Maslow’s (1968) characterization of highly creative, self-actualized people provides insight. Maslow called attention to how such people tried to explore creative possibilities in all of their activities, how they were often spontaneous in generating creative ideas, and how they tended not to fear their own creative thoughts or the evaluations of others. Maslow characterized genuine creativity as something that radiated like sunshine, touching and inspiring others. One aspect of being creative is to think of oneself as being creative. Developing an exploring attitude is also important in learning to become more creative. There are numerous ways in which a person can become fixated on a single interpretation or approach. This stifles creativity. To overcome functional fixedness and related tendencies, one should get into the habit of looking beyond conventional ideas. This was one of the themes that Secretary Gates made to field grade officers when he said “An unconventional era of warfare requires unconventional thinkers” (Miles, 2008, p. A3).

Creativity versus Competence

You must have some level of competence to be creative, but competence does not make you creative. Academics who develop sets of courses must distinguish between creativity and competence in developing a creativity training program. Spending large amounts of time on something often makes a person competent but not necessarily creative. A person could spend

years mastering the techniques of musical theory and composition, yet not be able to create unique music. Applying creative thinking techniques can complement expertise, allowing one to explore creative possibilities in such a way as to transcend mere competence. At the same time, the practice of these techniques will not necessarily lead to creative outcomes. Without having some expertise, there would be little opportunity for an individual to appreciate the appropriateness of a new idea, to comprehend its key problems, or even to express solutions in meaningful ways (Csikszentmihalyi, 1996).

Creativity in Education

One obvious application of the growth of creativity and cognitive complexity is to teach and foster the development of creativity in the educational system. However, if cognitive complexity and creativity occur separately and are not correlated, as this research suggests, then educators need to think of them as separate. A set of curriculum must be developed to enhance creativity and a separate set of curriculum developed to enhance cognitive complexity (Runco, 1991, 2006, 2007). Although various procedures have already been used by educational psychologists to try to enhance creative thinking in schools (i.e. Torrance & Myers, 1970), the novel experimental tasks used in studies on creative thinking can lead to the development of new, effective teaching methods and the construction of new measures of creative aptitude. Gary Klein's theory of the development of cognitive skills through his strategy of Recognition-Primed Decision (RPD) making model would be one way to develop cognitive complexity (Klein, 2001).

Applications in education of the RPD model to increase cognitive complexity would be to not teach formal methods of decision making (i.e., classes on the Military Decision Making Process or M.D.M.P.). Another application of the RPD model in the classroom would be to provide situations to students that would challenge them to decide when to compare options and when not; when to use intuition (Klein, 2001). An example of a situation or when to compare options would be when the student is a novice at the task, however, when the student has developed a certain level of expertise intuition should drive the decision making. Another application of the RPD model in the classroom would be to conduct as many practical applications as possible while putting stress on the students; for example using time as a stressor (Klein, 2001). This forces the student to develop a repertoire of experiences that would enhance their expertise, thus leading to more intuitive decision making (Klein, 2001).

Enhancing creativity in the classroom might be achieved by stimulating as many parts of the brain as you can during a block of instruction. Jennifer Magels showed in her research that brains that are being creative are stimulated over a wider area than those that are thinking at an auto-response level (Magels, 2007). David A. Kolb's Experiential Learning Model (ELM) attempts to stimulate different types of learning styles of learners in addition to various areas of the brain (Kolb, 2001). At the Command and General Staff School students are giving the Learning Styles Inventory in order to determine what type of learner they are: converger, diverger, assimilator, or accommodator (Kolb, 1976). This gives insight to the students and instructors as to what the strengths and weaknesses of the learning styles in the classroom are, that way teachers can structure lessons to challenge the students' non-dominant learning style. In the ELM, lessons are structured to "touch" each one of the learning styles through a "concrete experience, observation and reflection, form abstract concepts, and then test in new situations" (Kolb, 1975, p.52). The Kolb model might be one way to enhance creativity through the structure of the lesson plan, in addition to exercises and practical applications that instructors can have students do that directly force students to tap into their own creativity.

Michael Dickmann gives 101 different creativity strategies in his book, *Leading with the brain in mind: 101 brain compatible practices for leaders* (2003). By using "how to" books like Dickmann's, teachers can encourage creative thought through practical exercises in the classroom; exercises that emphasize divergent thinking as opposed to convergent thinking.

Other theorists such as Kegan and Steven Brookfield offer suggestions on how to improve cognitive complexity through practice. In *The Power of Critical Theory*, (2005) Brookfield offers suggestions on how to structure lessons and challenge students in order to develop their thinking abilities. Robert Kegan in his book, *The Evolving Self* (1982) suggests that learners develop through meaning-making. He states that through meaning making the learner helps to make sense of the world and in a Piagetian approach helps the learner to formulate their epistemological beliefs (1982). These are just a few of the methods that instructors can employ to enhance creativity and cognitive complexity in the classroom.

Predicting Future Threats

A critical task for the military is to predict future threats, to foresee future needs, and develop the capacity to meet those needs (Miles, 2008). Although using creative techniques has implications in being able to assist with these tasks, being creative does not allow a person to

predict the future. It does suggest that understanding the cognitive process involved in thinking creatively can contribute to more accurate predictions of what might happen. One of the most important contributions would be to encourage military planners to assess carefully any implicit assumptions that carry over from their conceptions of the world today. Predicting the future is basically a task of imagination, but just as designers might retain unnecessary features in trying to plan innovative designs, futurologists might retain inappropriate assumptions that will not hold in the world of the future.

There might be an application using creative methods in the exploration of creative performance in athletics. For instance, one might explore a generation of creative movements in gymnastics or figure skating and discover how these movements could be developed and refined.

There might be an application of creativity and cognitive complexity to help people improve interpersonal relationships. In applying creativity techniques to develop a new relationship, a person might want the relationship to start out ambiguously and seek to avoid defining it prematurely. The person might discover emergent shared features of the relationship that would make original expectations and criteria obsolete.

One of the purposes of this research was to explore the nature of creativity and cognition. People often claim to have their creativity inspired by listening to great music or seeing great works of art. What gives rise to these experiences of creative inspiration? In terms of creativity, it might be suspected that great music and art express potentially meaningful pre-inventive structures, which can lead to creative inspiration, but other factors inevitably, are involved as well. How do the effects of these inspirations work their way into creative expressions? It would be expected that our inspirations have a high degree of novelty and ambiguity and that emergence would result in a final product that was highly creative, but it is still not understood how this works on a cognitive level.

Recommendations for Future Research

There are some areas for future research that logically present themselves based on the outcomes of this research. They are:

1. Based on the positive correlations between combat tours and cognitive complexity, do high stress experiences such as combat have a positive impact on the cognitive complexity of an individual?

2. Why is there a positive correlation between female field grade officers and creativity, and are female military officers more creative and why?
3. There does appear to be a strong connection between cognitive complexity and the level of education, as Moore found in his research (1989), and there appears to be a strong connection between creativity and the level of education. Why do these two correlations exist?
4. Since military rank is a function of expertise, competence, and experience, one can conclude that expertise, competence, and experience might be positive influences on creativity and cognition. Why are there separate positive correlations between cognition and rank, and between creativity and rank?
5. It was not determined whether the curriculum on cognitive complexity and creativity is effective at improving performance in these domains at military intermediate level education institutions. Since it was shown that creativity and cognitive complexity are in fact not correlated to each other, does the curriculum at military academic institutions improve levels of creativity and cognitive complexity?
6. The TTCT and LEP instruments were used to test the correlation between cognitive complexity and creativity. Would there be similar correlation if other instruments were used to measure the levels of creativity and cognitive complexity in field grade officers?

In addition to these, a more scientific methodology would increase the understanding of the nature of these correlations. The use of a control group and treatment group in any of these studies would help to show causality, instead of just correlations. This might help us to answer whether curriculum at academic institutions is effective. Is creativity enhanced at military intermediate level academic institutions, and is cognitive complexity enhanced as well? Since the military believes creativity and cognitive complexity are important, is the military effective in preparing its officers to be more creative and to think at a higher cognitive level in order to solve the military problems of the future? That question still remains to be answered.

Summary

If what Secretary Gates said is true, that creative “out-of-the-box thinking” is important, and that “the officer that is a deep thinker who advances strategy in meeting complex challenges” is what the military needs in the future, then academics need to understand how creativity and cognitive complexity are manifested (Miles, 2008, p. A3). Is the military providing the educational environment that facilitates this? According to Gates, there exists “a large measure of bureaucratic resistance and institutional hostility” to creativity (Miles, 2008, p. A3). If creativity and cognitive complexity are important things, then according to the results of this research, educators need to think about these things as being different. Instructors can’t think that they are educating for creativity while they are educating for cognitive complexity, and vice versa. Teachers need to understand how to educate for creativity and cognitive complexity separately.

Robert Kegan in his book *In Over Our Heads* (1994), states that we constantly confront a bewildering array of expectations and claims, as well as an equally confusing assortment of expert opinions on how things fit together. Kegan says that frequently we encounter frustration in trying to understand complex and conflicting claims in ours results from a mismatch between the way we ordinarily know the world and the way we are unwittingly expected to understand it (1994). This is similar to the findings in this research, that while they align with the way Gardner (1993, 1996) and Sternberg (1999) understand creativity and cognitive complexity, the findings conflict with other assertions by some neuroscientists and cognitive psychologists such as Finke (1996). This research expands the literature on creativity and cognitive complexity, but more research needs to be done to fully understand how creativity and cognitive complexity exist in the mind and is developed in individuals over time.

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Appendix A - LEP CCI and TTCT Scores for Subjects

Subject	LEP CCI	TTCT- Raw-Ave	TTCT- Normed- Ave	TTCT- Figural- Raw	TTCT- Figural- Normed	TTCT- Verbal-Raw	TTCT- Verbal- Normed
1	403.00	132.00	94.00	132.0	94.00	132.0	95.00
2	420.00	100.50	50.00	96.00	40.00	105.0	60.00
3	337.00	117.00	75.50	122.0	79.00	112.0	72.00
4	352.00	97.00	33.00	99.00	25.00	95.00	41.00
5	438.00	100.50	39.50	98.00	23.00	103.0	56.00
6	357.00	121.50	82.50	124.0	84.00	119.0	81.00
7	400.00	104.50	48.00	107.0	42.00	102.0	54.00
8	420.00	107.00	50.00	97.00	21.00	117.0	79.00
9	425.00	128.00	90.50	133.0	95.00	123.0	86.00
10	418.00	124.00	86.00	127.0	88.00	121.0	84.00
11	383.00	114.50	69.00	115.0	63.00	114.0	75.00
12	260.00	91.00	26.50	84.00	7.00	98.00	46.00
13	430.00	91.50	25.50	89.00	11.00	94.00	40.00
14	321.00	93.00	29.00	87.00	10.00	99.00	48.00
15	355.00	112.00	63.00	111.0	53.00	113.0	73.00
16	410.00	132.00	94.00	131.0	93.00	133.0	95.00
17	390.00	115.50	69.50	114.0	60.00	117.0	79.00
18	395.00	85.00	20.50	77.00	3.00	93.00	38.00
19	337.00	127.00	89.00	127.0	88.00	127.0	90.00
20	430.00	102.00	42.50	98.00	23.00	106.0	62.00
21	423.00	96.50	33.50	92.00	15.00	101.0	52.00
22	438.00	131.00	94.00	132.0	94.00	130.0	94.00
23	420.00	100.50	40.00	96.00	20.00	105.0	60.00
24	352.00	117.00	75.50	122.0	79.00	112.0	72.00
25	421.00	97.00	33.00	99.00	25.00	95.00	41.00
26	403.00	104.50	46.50	98.00	23.00	111.0	70.00
27	398.00	122.50	83.50	125.0	85.00	120.0	82.00
28	392.00	102.50	43.50	103.0	33.00	102.0	54.00
29	260.00	106.00	33.00	97.00	21.00	115.0	45.00
30	420.00	128.00	90.50	133.0	95.00	123.0	86.00
31	429.00	122.50	83.50	123.0	82.00	122.0	85.00

32	414.00	113.00	65.00	112.0	55.00	114.0	75.00
33	379.00	92.00	27.00	86.00	8.00	98.00	46.00
34	423.00	90.00	22.50	88.00	10.00	92.00	35.00
35	331.00	93.00	29.00	87.00	10.00	99.00	48.00
36	410.00	113.50	66.50	114.0	60.00	113.0	73.00
37	345.00	130.00	93.00	131.0	93.00	129.0	93.00
38	390.00	113.00	64.50	111.0	53.00	115.0	76.00
39	367.00	85.50	21.00	78.00	4.00	93.00	38.00
40	430.00	126.50	88.00	126.0	87.00	125.0	89.00
41	414.00	102.00	42.50	98.00	23.00	106.0	62.00
42	423.00	96.50	33.50	92.00	15.00	101.0	52.00
43	438.00	131.00	94.00	132.0	94.00	130.0	94.00
44	420.00	100.50	40.00	96.00	20.00	105.0	60.00
45	421.00	118.00	78.00	124.0	84.00	112.0	72.00
46	380.00	97.00	33.00	99.00	25.00	95.00	41.00
47	413.00	102.00	43.00	94.00	17.00	110.0	69.00
48	352.00	123.50	85.00	128.0	90.00	118.0	80.00
48	403.00	100.50	39.50	99.00	25.00	102.0	54.00
50	430.00	106.00	48.50	97.00	21.00	115.0	76.00
51	303.00	128.50	91.50	133.0	95.00	124.0	88.00
52	438.00	121.00	81.00	121.0	78.00	121.0	84.00
53	414.00	116.00	72.50	118.0	70.00	114.0	75.00
54	430.00	91.50	27.00	85.00	8.00	98.00	46.00
55	427.00	91.50	25.00	90.00	12.00	93.00	38.00
56	321.00	93.00	29.00	87.00	10.00	99.00	48.00
57	400.00	112.00	63.00	111.0	53.00	113.0	73.00
58	395.00	130.00	93.00	131.0	93.00	129.0	93.00
59	388.00	115.00	68.50	113.0	58.00	117.0	79.00
60	367.00	85.50	19.50	79.00	4.00	92.00	35.00
61	443.00	126.00	90.00	127.0	88.00	128.0	92.00
62	440.00	102.00	41.00	98.00	23.00	104.0	59.00
63	443.00	96.50	33.50	92.00	15.00	101.0	52.00
64	438.00	131.00	94.00	132.0	94.00	130.0	94.00
65	420.00	100.50	40.00	96.00	20.00	105.0	60.00
66	373.00	116.50	75.00	121.0	78.00	112.0	72.00
67	377.00	97.50	34.00	99.00	25.00	96.00	43.00

68	267.00	101.50	42.00	94.00	17.00	109.0	67.00
69	418.00	123.00	85.00	128.0	90.00	118.0	80.00
70	438.00	105.00	48.00	102.0	31.00	108.0	65.00
71	420.00	106.50	49.50	97.00	21.00	116.0	78.00
72	260.00	125.00	87.00	127.0	88.00	123.0	86.00
73	418.00	122.00	82.00	122.0	79.00	122.0	85.00
74	383.00	115.00	70.00	116.0	65.00	114.0	75.00
75	379.00	92.00	27.00	86.00	8.00	98.00	46.00
76	430.00	90.00	23.00	89.00	11.00	92.00	35.00
77	321.00	94.00	29.50	89.00	11.00	99.00	48.00
78	410.00	112.00	63.00	111.0	53.00	113.0	73.00
79	355.00	130.00	93.00	131.0	93.00	129.0	93.00
80	362.00	116.50	73.00	117.0	68.00	116.0	78.00
81	357.00	85.50	25.50	80.00	17.00	91.00	34.00
82	430.00	127.00	89.00	127.0	88.00	127.0	90.00
83	421.00	102.00	42.50	98.00	23.00	106.0	62.00
84	423.00	97.00	39.00	93.00	16.00	101.0	62.00
85	438.00	132.00	93.50	132.0	94.00	132.0	95.00
86	376.00	100.50	40.00	96.00	20.00	105.0	60.00
87	390.00	116.00	74.50	123.0	82.00	109.0	67.00
88	352.00	98.50	35.50	101.0	28.00	96.00	43.00
89	403.00	100.50	40.50	94.00	17.00	107.0	64.00
90	375.00	122.00	83.00	124.0	84.00	120.0	82.00
91	400.00	104.00	46.50	105.0	37.00	103.0	56.00
92	372.00	106.50	49.50	97.00	21.00	116.0	78.00
93	260.00	128.50	91.50	133.0	95.00	124.0	88.00
94	429.00	121.50	81.50	121.0	78.00	122.0	85.00
95	414.00	113.00	66.50	115.0	63.00	111.0	70.00
96	427.00	91.50	26.00	86.00	8.00	97.00	44.00
97	379.00	90.50	23.00	90.00	12.00	91.00	34.00
98	331.00	93.00	29.00	87.00	10.00	99.00	48.00
99	410.00	112.00	63.00	111.0	53.00	113.0	73.00
100	380.00	130.00	93.00	131.0	93.00	129.0	93.00
101	390.00	114.00	67.00	113.0	58.00	115.0	76.00
102	367.00	83.50	18.50	76.00	3.00	91.00	34.00
103	430.00	126.50	88.00	126.0	87.00	125.0	89.00

104	414.00	102.00	42.50	98.00	23.00	106.0	62.00
105	378.00	96.50	33.00	93.00	16.00	100.0	50.00
106	438.00	131.00	94.00	132.0	94.00	130.0	94.00
107	375.00	101.00	40.50	97.00	21.00	105.0	60.00
108	379.00	116.50	75.00	121.0	78.00	112.0	72.00
109	361.00	97.50	34.00	99.00	25.00	96.00	43.00
110	413.00	98.00	35.50	94.00	17.00	102.0	54.00
111	403.00	119.50	79.00	121.0	78.00	118.0	80.00
112	325.00	101.00	40.50	100.0	27.00	102.0	54.00
113	303.00	106.00	48.50	97.00	21.00	115.0	76.00
114	430.00	125.00	87.50	126.0	87.00	124.0	88.00
115	438.00	121.50	81.50	121.0	78.00	122.0	85.00
116	414.00	112.50	64.00	111.0	53.00	114.0	75.00
117	430.00	91.00	26.50	85.00	8.00	97.00	45.00
118	370.00	89.00	21.00	88.00	10.00	90.00	32.00
119	321.00	93.00	29.00	87.00	10.00	99.00	48.00
120	400.00	112.50	64.00	112.0	55.00	113.0	73.00
121	345.00	130.00	93.00	131.0	93.00	129.0	93.00
122	387.00	114.00	66.00	111.0	53.00	117.0	79.00
123	367.00	86.50	22.00	79.00	4.00	94.00	40.00
124	443.00	126.50	90.00	127.0	88.00	128.0	92.00
125	440.00	102.00	43.50	98.00	23.00	106.0	62.00
126	443.00	97.00	34.00	93.00	16.00	101.0	52.00

Appendix B - Demographic Data of Subjects

Subject	Gender	Age	Cmbt	Direct/ Indirect	Length of Tour	Rank	Service	Civ Ed	Mil Ed
1	Male	40.00	Yes	Direct	24.0	LTC	Army	Doctor	Staff College
2	Male	35.00	Yes	Indirect	12.0	Major	Navy	Master	Staff College
3	Male	43.00	No	No combat	.00	LTC	Army	Master	Staff College
4	Male	39.00	Yes	Direct	24.0	Major	Army	Bachelor	Staff College
5	Male	34.00	Yes	Direct	12.0	Major	Air Force	Master	Staff College
6	Male	44.00	Yes	Direct	18.0	LTC	Air Force	Master	War College
7	Male	40.00	Yes	Direct	12.0	LTC	Army	Master	Staff College
8	Male	35.00	Yes	Direct	6.00	Major	Marines	Master	Staff College
9	Male	42.00	No	No combat	.00	Major	Air Force	Master	Staff College
10	Male	40.00	Yes	Direct	24.0	Major	Army	Master	Staff College
11	Male	40.00	No	No combat	.00	LTC	Navy	Master	Staff College
12	Male	43.00	Yes	Indirect	48.0	LTC	Navy	Master	Staff College
13	Male	42.00	Yes	Indirect	18.0	LTC	Air Force	Master	Staff College
14	Male	37.00	Yes	Indirect	12.0	Major	Army	Bachelor	Staff College
15	Male	37.00	No	No combat	.00	Major	Air Force	Master	Staff College
16	Male	38.00	No	No combat	.00	LTC	Navy	Master	Staff College

17	Male	34.00	Yes	Indirect	12.0	Major	Marines	Master	Staff College
18	Male	41.00	No	No combat	.00	Major	Navy	Master	Staff College
19	Female	39.00	Yes	Indirect	24.0	LTC	Army	Master	Staff College
20	Male	44.00	Yes	Indirect	42.0	LTC	Air Force	Master	Staff College
21	Male	41.00	Yes	Indirect	12.0	LTC	Air Force	Master	Staff College
22	Male	40.00	Yes	Direct	24.0	LTC	Army	Doctor	Staff College
23	Male	35.00	Yes	Direct	12.0	Major	Navy	Master	Staff College
24	Male	43.00	No	No combat	.00	LTC	Army	Master	Staff College
25	Male	39.00	Yes	Direct	24.0	Major	Army	Bachelor	Staff College
26	Male	34.00	Yes	Direct	12.0	Major	Air Force	Master	Staff College
27	Male	44.00	Yes	Direct	18.0	LTC	Air Force	Master	War College
28	Male	40.00	Yes	Direct	12.0	LTC	Army	Master	Staff College
29	Male	36.00	Yes	Direct	6.00	Major	Marines	Master	Staff College
30	Male	42.00	No	No combat	.00	Major	Air Force	Doctor	Staff College
31	Male	40.00	Yes	Direct	24.0	Major	Army	Master	Staff College
32	Female	40.00	No	No combat	.00	LTC	Navy	Master	Staff College
33	Male	43.00	Yes	Indirect	48.0	LTC	Navy	Master	Staff College
34	Male	42.00	Yes	Indirect	18.0	LTC	Air Force	Master	Staff College

35	Male	37.00	Yes	Direct	12.0	Major	Army	Bachelor	Staff College
36	Male	37.00	No	No combat	.00	Major	Air Force	Master	Staff College
37	Female	38.00	No	No combat	.00	LTC	Navy	Master	Staff College
38	Male	34.00	Yes	Indirect	12.0	Major	Marines	Master	Staff College
39	Male	41.00	No	No combat	.00	Major	Navy	Master	Staff College
40	Female	39.00	Yes	Indirect	24.0	LTC	Army	Master	Staff College
41	Male	44.00	Yes	Direct	42.0	LTC	Air Force	Master	Staff College
42	Male	41.00	Yes	Indirect	12.0	LTC	Air Force	Master	Staff College
43	Male	40.00	Yes	Direct	24.0	LTC	Army	Doctor	Staff College
44	Male	35.00	Yes	Indirect	12.0	Major	Navy	Master	Staff College
45	Male	43.00	No	No combat	.00	LTC	Army	Master	Staff College
46	Male	39.00	Yes	Direct	24.0	Major	Army	Bachelor	Staff College
47	Male	34.00	Yes	Direct	12.0	Major	Air Force	Master	Staff College
48	Male	44.00	Yes	Direct	18.0	LTC	Air Force	Master	War College
48	Male	40.00	Yes	Direct	12.0	LTC	Army	Master	Staff College
50	Female	36.00	Yes	Indirect	6.00	Major	Marines	Master	Staff College
51	Male	42.00	No	No combat	.00	Major	Air Force	Master	Staff College
52	Male	40.00	Yes	Direct	24.0	Major	Army	Master	Staff College

53	Female	40.00	No	No combat	.00	LTC	Navy	Master	Staff College
54	Male	43.00	Yes	Indirect	48.0	LTC	Navy	Master	Staff College
55	Male	42.00	Yes	Direct	18.0	LTC	Air Force	Master	Staff College
56	Male	37.00	Yes	Indirect	12.0	Major	Army	Bachelor	Staff College
57	Male	37.00	No	No combat	.00	Major	Air Force	Master	Staff College
58	Female	38.00	No	No combat	.00	LTC	Navy	Master	Staff College
59	Male	34.00	Yes	Indirect	12.0	Major	Marines	Master	Staff College
60	Male	41.00	No	No combat	.00	Major	Navy	Master	Staff College
61	Male	39.00	Yes	Direct	24.0	LTC	Army	Master	Staff College
62	Male	44.00	Yes	Indirect	42.0	LTC	Air Force	Master	Staff College
63	Male	41.00	Yes	Indirect	12.0	LTC	Air Force	Doctor	Staff College
64	Male	40.00	Yes	Direct	24.0	LTC	Army	Doctor	Staff College
65	Male	35.00	Yes	Indirect	12.0	Major	Navy	Master	Staff College
66	Male	43.00	No	No combat	.00	LTC	Army	Master	Staff College
67	Male	39.00	Yes	Direct	24.0	Major	Army	Bachelor	Staff College
68	Male	34.00	Yes	Direct	12.0	Major	Air Force	Master	Staff College
69	Female	44.00	Yes	Indirect	18.0	LTC	Air Force	Master	War College
70	Male	40.00	Yes	Direct	12.0	LTC	Army	Master	Staff College

71	Male	36.00	Yes	Direct	6.00	Major	Marines	Master	Staff College
72	Male	42.00	No	No combat	.00	Major	Air Force	Master	Staff College
73	Male	40.00	Yes	Direct	24.0	Major	Army	Master	Staff College
74	Male	40.00	No	No combat	.00	LTC	Navy	Master	Staff College
75	Male	43.00	Yes	Indirect	48.0	LTC	Navy	Master	Staff College
76	Male	42.00	Yes	Indirect	18.0	LTC	Air Force	Master	Staff College
77	Male	37.00	Yes	Indirect	12.0	Major	Army	Bachelor	Staff College
78	Male	37.00	No	No combat	.00	Major	Air Force	Master	Staff College
79	Male	38.00	No	No combat	.00	LTC	Navy	Master	Staff College
80	Female	34.00	Yes	Indirect	12.0	Major	Marines	Master	Staff College
81	Male	41.00	No	No combat	.00	Major	Navy	Master	Staff College
82	Male	39.00	Yes	Direct	24.0	LTC	Army	Master	Staff College
83	Male	44.00	Yes	Direct	42.0	LTC	Air Force	Master	Staff College
84	Male	41.00	Yes	Indirect	12.0	LTC	Air Force	Master	Staff College
85	Male	40.00	Yes	Direct	24.0	LTC	Army	Doctor	Staff College
86	Male	35.00	Yes	Indirect	12.0	Major	Navy	Master	Staff College
87	Male	43.00	No	No combat	.00	LTC	Army	Master	Staff College
88	Male	39.00	Yes	Direct	24.0	Major	Army	Bachelor	Staff College

89	Female	34.00	Yes	Indirect	12.0	Major	Air Force	Master	Staff College
90	Male	44.00	Yes	Direct	18.0	LTC	Air Force	Master	War College
91	Male	40.00	Yes	Direct	12.0	LTC	Army	Master	Staff College
92	Male	36.00	Yes	Direct	6.00	Major	Marines	Master	Staff College
93	Male	42.00	No	No combat	.00	Major	Air Force	Master	Staff College
94	Male	40.00	Yes	Direct	24.0	Major	Army	Master	Staff College
95	Male	40.00	No	No combat	.00	LTC	Navy	Master	Staff College
96	Male	43.00	Yes	Indirect	48.0	LTC	Navy	Master	Staff College
97	Male	42.00	Yes	Indirect	18.0	LTC	Air Force	Master	Staff College
98	Male	37.00	Yes	Indirect	12.0	Major	Army	Bachelor	Staff College
99	Female	37.00	No	No combat	.00	Major	Air Force	Master	Staff College
100	Male	38.00	No	No combat	.00	LTC	Navy	Master	Staff College
101	Male	34.00	Yes	Indirect	12.0	Major	Marines	Master	Staff College
102	Male	41.00	No	No combat	.00	Major	Navy	Master	Staff College
103	Male	39.00	Yes	Direct	24.0	LTC	Army	Master	Staff College
104	Female	44.00	Yes	Indirect	42.0	LTC	Air Force	Master	Staff College
105	Male	41.00	Yes	Indirect	12.0	LTC	Air Force	Doctor	Staff College
106	Male	40.00	Yes	Direct	24.0	LTC	Army	Doctor	Staff College

107	Male	35.00	Yes	Indirect	12.0	Major	Navy	Master	Staff College
108	Male	43.00	No	No combat	.00	LTC	Army	Master	Staff College
109	Male	39.00	Yes	Direct	24.0	Major	Army	Bachelor	Staff College
110	Male	34.00	Yes	Direct	12.0	Major	Air Force	Master	Staff College
111	Male	44.00	Yes	Direct	18.0	LTC	Air Force	Master	War College
112	Male	40.00	Yes	Direct	12.0	LTC	Army	Master	Staff College
113	Female	36.00	Yes	Indirect	6.00	Major	Marines	Master	Staff College
114	Male	42.00	No	No combat	.00	Major	Air Force	Master	Staff College
115	Male	40.00	Yes	Direct	24.0	Major	Army	Master	Staff College
116	Male	40.00	No	No combat	.00	LTC	Navy	Master	Staff College
117	Male	43.00	Yes	Indirect	48.0	LTC	Navy	Master	Staff College
118	Male	42.00	Yes	Indirect	18.0	LTC	Air Force	Master	Staff College
119	Male	37.00	Yes	Indirect	12.0	Major	Army	Bachelor	Staff College
120	Female	37.00	No	No combat	.00	Major	Air Force	Master	Staff College
121	Male	38.00	No	No combat	.00	LTC	Navy	Master	Staff College
122	Male	34.00	Yes	Indirect	12.0	Major	Marines	Master	Staff College
123	Male	41.00	No	No combat	.00	Major	Navy	Master	Staff College
124	Male	39.00	Yes	Direct	24.0	LTC	Army	Master	Staff College

125	Male	44.00	Yes	Indirect	42.0	LTC	Air Force	Master	Staff College
126	Male	41.00	Yes	Indirect	12.0	LTC	Air Force	Master	Staff College

Appendix C - Permission to Use Learning Environments Preference Instrument

4) Provide any additional follow-up necessary for the interpretation of the instrument scores or summary sheets.

5) SPECIAL NOTES/REVISIONS OF TERMS:

Instrument/s Requested:

MID _____ Indicate preferences: 1) Essay Form/s: A ___ AP ___ Q ___ Other*? ___

2) Rating options:

Single-rated? ___

Double-rated? ___

Single-rated, with double-rated sub-sample? ___

LEP 112

*Essays A, AP, and Q are the primary essays used for measuring general epistemological issues related to the Perry scheme. Alternative essays are available for research on other specific domains, e.g., careers, decision-making, specific academic disciplines (math, humanities, science). For more information about these essays, or potential work on other variant essays, contact the Center Coordinator.

Cladwick W. Clark Cladwick
 Name of Principal Researcher Signature

Kansas State University 3 Jan 08
 Institution Date

211 Pope Ave 913-682-7050
 Address Phone (w/ AC)

Fort Leavenworth KS 66027 Cladwick@ksu.edu
 City/State/Zip Code Email address

William S. Moore 1/7/08
 William S. Moore, Coordinator, CSID Date

Please attach a brief description of your assessment project: basic purpose, hypotheses, population/s sampled, sample size, and time frame for data collection and analyses.

Appendix D - Informed Consent Form

KANSAS STATE UNIVERSITY

INFORMED CONSENT

PROJECT TITLE: ESTIMATES OF ASSOCIATION BETWEEN COGNITIVE THINKING LEVELS AND CREATIVITY LEVELS OF FIELD GRADE OFFICERS IN THE MILITARY

APPROVAL DATE OF PROJECT: TBD **EXPIRATION DATE OF PROJECT:** TBD

PRINCIPAL INVESTIGATOR: Dr Jane Fishback

CO-INVESTIGATOR: Chadwick W. Clark

CONTACT NAME AND PHONE FOR ANY PROBLEMS/QUESTIONS: Dr Jane Fishback, jfishbac@ksu.edu, (785) 532-5554

IRB CHAIR CONTACT/PHONE INFORMATION:

- Rick Scheidt, Chair, Committee on Research Involving Human Subjects, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.
- Jerry Jaax, Associate Vice Provost for Research Compliance and University Veterinarian, 203 Fairchild Hall, Kansas State University, Manhattan, KS 66506, (785) 532-3224.

PURPOSE OF THE RESEARCH: This project investigates whether there is an association between cognitive thinking levels and creativity levels in field grade officers in the military.

PROCEDURES OR METHODS TO BE USED: The project is going to compare cognitive thinking levels as determined by scores on the Learning Environments Preference (LEP) survey to creativity levels as determined by scores on the Torrance Tests of Creative Thinking (TTCT).

LENGTH OF STUDY: approximately 2 hours.

BENEFITS ANTICIPATED: This study will benefit the Department of Defense in its understanding of cognitive thinking levels and their correlation to creativity. Your participation in this study will help to enhance this understanding.

EXTENT OF CONFIDENTIALITY: Your name will not be associated in any way to the results that are presented in this study. Your survey data will be assigned a subject number and that is how your survey data will be referred to in this study. Your name will be held on record for the purpose of verifying the legitimacy of the results in this study. Your name will not be released to any third parties.

TERMS OF PARTICIPATION: I understand this project is research, and that my participation is completely voluntary. I also understand that if I decide to participate in this study, I may withdraw my consent at any time, and stop participating at any time without explanation, penalty, or loss of benefits, or academic standing to which I may otherwise be entitled. I verify that my signature below indicates that I have read and understand this consent form, and willingly agree to participate in this study under the terms described, and that my signature acknowledges that I have received a signed and dated copy of this consent form.

Participant Name: _____

•

• **Participant
Signature:** _____

Date: _____

Witness to Signature: (project staff) _____

Date: _____

Appendix E - Student Information Form

Name _____

Rank _____

Branch of Service _____

Age _____

Gender _____

Education:

Civilian:

Bachelor _____ Master _____ Doctorate _____

Military:

Staff College _____ War College _____

Combat Experience:

Yes _____ No _____

Length of Time (months):

6 _____ 12 _____ 18 _____ 24 _____ 30 _____ 36 _____ 42 _____ 48+ _____

Direct Combat:

Yes _____ No _____





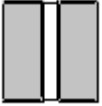





Appendix F - Kendall's Tau Correlations











			LEP Scores	TTCT average raw score	Branch of Service	Military Rank	Age of subject	Gender of subject	Civilian Education Level	Length of combat tour
tau_b	LEP Scores	Correlation Coefficient	1.000	.083	-.005	.228(**)	.102	-.027	.345(**)	.246(**)
		Sig. (2-tailed)	.	.177	.944	.002	.109	.718	.000	.002
		N	126	126	126	126	126	126	126	90
	TTCT average raw score	Correlation Coefficient	.083	1.000	-.074	.150(*)	-.033	.151(*)	.341(**)	.059
		Sig. (2-tailed)	.177	.	.280	.042	.609	.041	.000	.460
		N	126	126	126	126	126	126	126	90
	Branch of Service	Correlation Coefficient	-.005	-.074	1.000	-.167(*)	-.035	.143	.179(*)	-.336(**)
		Sig. (2-tailed)	.944	.280	.	.043	.621	.083	.027	.000
		N	126	126	126	126	126	126	126	90
	Military Rank	Correlation Coefficient	.228(**)	.150(*)	-.167(*)	1.000	.516(**)	.034	.367(**)	.411(**)
		Sig. (2-tailed)	.002	.042	.043	.	.000	.706	.000	.000
		N	126	126	126	126	126	126	126	90
	Age of subject	Correlation Coefficient	.102	-.033	-.035	.516(**)	1.000	-.133	.161(*)	.465(**)
		Sig. (2-tailed)	.109	.609	.621	.000	.	.084	.032	.000
		N	126	126	126	126	126	126	126	90
	Gender of subject	Correlation Coefficient	-.027	.151(*)	.143	.034	-.133	1.000	.022	-.064
		Sig. (2-tailed)	.718	.041	.083	.706	.084	.	.801	.505
		N	126	126	126	126	126	126	126	90
	Civilian Education Level	Correlation Coefficient	.345(**)	.341(**)	.179(*)	.367(**)	.161(*)	.022	1.000	.068
		Sig. (2-tailed)	.000	.000	.027	.000	.032	.801	.	.468
		N	126	126	126	126	126	126	126	90
	Length of combat tour	Correlation Coefficient	.246(**)	.059	-.336(**)	.411(**)	.465(**)	-.064	.068	1.000
		Sig. (2-tailed)	.002	.460	.000	.000	.000	.505	.468	.
		N	90	90	90	90	90	90	90	90

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Appendix G - Military Commissioned Officer Ranks

	Army/Air Force/Marines	Navy/ Coast Guard
O-1		
	Second Lieutenant (Army - 2LT) (Air Force - 2d Lt) (USMC - 2dLt)	Ensign (ENS)
O-2		
	First Lieutenant (Army - 1LT) (Air Force - 1st Lt) (USMC - 1Lt)	Lieutenant Junior Grade (LTJG)
O-3		
	Captain (Army - CPT) (Air Force - Capt) (USMC - Capt)	Lieutenant (LT)
O-4		
	Major (Army - MAJ) (Air Force - Maj) (USMC - Maj)	Lieutenant Commander (LCDR)
O-5		
	Lieutenant Colonel (Army - LTC) (Air Force - Lt Col) (USMJ - LtCol)	Commander (CDR)

O-6		
	Colonel (Army - COL) (Air Force - Col) (USMC - Col)	Captain (CAPT)
O-7		
	Brigadier General (Army - BG) (Air Force - Brig Gen) (USMC - BGen)	Rear Admiral (lower half) (RDML)
O-8		
	Major General (Army - MG) (Air Force Maj Gen) (USMC - MGen)	Rear Admiral (upper half) (RADM)
O-9		
	Lieutenant General (Army LTG) (Air Force - Lt Gen) (USMC - LtGen)	Vice Admiral (VADM)
O-10		
	General (Army - GEN) (Air Force - Gen) (USMC - Gen)	Admiral (ADM)
Note: The Navy also uses Air Force/Army/Marine style rank on the collar.		