AN INVESTIGATION INTO THE RELATIONSHIP BETWEEN TOLERANCE OF AMBIGUITY AND CREATIVITY AMONG MILITARY OFFICERS

by

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AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

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Abstract

This study investigated the relationship between the tolerance of ambiguity (AT) levels of the officers attending the U.S. Army's School of Advanced Military Studies (SAMS) and the creativity of the military plans they developed. Located aboard Fort Leavenworth, KS, SAMS is an Army school providing education to specially selected officers in preparation for duties in positions as battalion commanders and lead planners for Army divisions and corps. The officers at SAMS are grouped into seminars for their classes, and they remain with their seminars throughout the yearlong educational program.

The twin purposes of this study were to (a) test for the relationship between AT and creativity suggested by various theories of creativity and (b) contribute to the Army's efforts to increase the creativity of its officers by empirically identifying the expected positive correlation between the officers AT levels and the creativity of their plans. A sample of 66 officers participated in the study. They each independently developed a military plan in response to a common notional scenario. Subsequently they each independently completed the short version of Norton's (1975) MAT-50 to measure their levels of AT. Their plans were assessed for creativity using Amabile's Consensual Assessment Technique (CAT). The high inter-rater reliability among the judges ($r = .82$) demonstrated the effectiveness of the CAT as a method for assessing the creativity of military plans.

Counter to the expectation, analysis of the data revealed a small negative correlation throughout the sample between AT scores and the creativity of the plans, producing a disconfirmation dilemma for the researcher. Analysis revealed that the sample's collective levels of AT differed among the various subscales of the MAT-50. Additionally, *post hoc* analysis

revealed statistically significant variance of the creativity of the officers' plans between the different seminars to which they were assigned. In the seminar with the highest creativity scores, there was a small positive correlation between AT and creativity, while in the seminar with the lowest creativity scores, there was a medium sized negative correlation between the two variables. Implications of these findings and recommendations for future research are discussed.

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CHAPTER 1 - INTRODUCTION

Overview

This research investigated the relationship between tolerance of ambiguity levels and creativity levels in field grade officers at the United States Army's School of Advanced Military Studies, Fort Leavenworth, Kansas. This chapter provides an overview of the study, including the purpose of the research, the research questions, and the methodology of the research. The chapter also provides an overview of the body of literature and the theoretical basis for the hypotheses, as well as definitions of key terms. The chapter concludes with a summary of the significance of the research.

Background

"Nothing is so disgraceful as slavishness to custom; this is both a result of ignorance and a proof of it." Marshal Maurice de Saxe (as cited in Phillips, 1985, p. 190)

Near the end of the 16th century, the forces of Japanese ruler Hideyoshi invaded Korea. Armed with muskets provided by the Portuguese, the Japanese forces were easily defeating the Korean defenders and had quickly conquered Seoul (Turnbull, 2008). Just when the situation appeared without hope for the Koreans, Admiral Yi Sun-Shin of the Korean navy arrived with a small fleet of warships unlike any that the Japanese had seen before. Called "turtle ships" due to a visible resemblance to their reptilian namesakes, these revolutionary vessels were the world's first ironclad warships (Bak, 1977). Some years before, Admiral Yi had personally envisioned and designed these warships, and when the government would not allocate the money to have them built, Admiral Yi had personally secured private financing to fund them (Bak, 1977). In

addition to the metal armor, which protected the vessels from their adversaries' cannons, their metal roofs were covered in sharp metal spikes. These spikes prevented adversaries from effectively boarding the turtle ships (Bak, 1977). In the decisive engagement, despite numbering only 12, they attacked the Japanese fleet consisting of 133 ships and sank 31 of them before the remainder withdrew. This action denied the Japanese naval access to the Yellow Sea, thereby preventing them from resupplying their land forces (Turnbull, 2008). As a result, Japan was subsequently forced to end their attack and withdraw from the Korean peninsula (Turnbull, 2008).

History is replete with such stories, where the innovations of creative leaders resulted in great military success (Taylor, Rosenbach & Rosenbach, 2008). Some of these innovations involved the development of entirely new weapons or systems, like Admiral Yi's ironclad turtle ships. Some of them involved new and innovative applications of an existing weapon system, such as the United States' launching of land-based bombers from aircraft carriers during the Doolittle Raid, which enabled planes to bomb the mainland Japanese island of Honshu in April of 1942 (Glines, 2000).

In some cases, creative military leaders developed new and innovative tactics, like Major Pete Ellis of the United States Marine Corps, who anticipated the nature of the Pacific theater of war in WWII and led the development of the doctrine for conducting amphibious assaults in the 1930s (Millett, 1980). In other cases, creative military leaders achieved great successes through the creative application of established tactics in a new and unexpected way, such as MacArthur's amphibious envelopment of the North Korean forces at Inchon in 1950 (Langley, 1979).

At the opposite end of the spectrum, military leaders who lacked creativity were often recognized as failures and studied as examples not to be followed (Cohen & Gooch, 1990;

Tuchman, 1962). Throughout the history of military conflict, the side whose leaders were able to learn, adapt, and innovate faster possessed a decided advantage over their adversaries (Cohen & Gooch, 1990; Luttwak, 1987). Because the waging of war is a competitive event, the actions and reactions of each side largely determine the success of the other. In what Luttwak (1987, p.16) called "the paradoxical logic of strategy," the best option that a particular commander may have available stands to be the worst if chosen, precisely because it was the best. By this, Luttwak meant that the more predictable a commander's actions are by his adversary, the more prepared the adversary will be to counter them. Thus, MacArthur's landing at Inchon and Admiral Yi's turtle boats were tremendously successful for the same reason–they were unanticipated, and therefore caught their enemies unprepared.

The need for military leaders to be highly creative is not a thing of the past; in fact, the need may well be higher for the military leader of today than for leaders at any time previous to this (Clark, 2008). The modern battlefield is more complex than ever, and the types of missions that today's military leaders find themselves on are typically more ambiguous than ever (Clark, 2008; Hagee, Personal communication, January 8, 2008). Roughly 10 years ago, General Charles Krulak, at the time the Commandant of the Marine Corps, gave a prescient speech describing his vision of the future environment in which American military forces would likely operate:

> It will be an asymmetrical battlefield…our enemies will not allow us to fight the Son of Desert Storm, but will try to draw us into the stepchild of Chechnya. In one moment in time, our service members will be feeding and clothing displaced refugees, providing humanitarian assistance. In the next moment, they will be holding warring tribes apart–conducting peacekeeping operations–and finally, they will be fighting a highly lethal mid-intensity battle—all on the same day…all within three city blocks. (as cited in McCaffrey, 2007, p. 5)

Events in Afghanistan and Iraq have developed much as General Krulak predicted. American military forces are engaged in actions that range from fighting in intense combat to

running town meetings and building schools. The cognitive demands placed upon leaders in operational environments such as these are immense (Davis, 2008). Military leaders are increasingly faced with complex situations for which they have no readily available textbook solution to apply (Clark, 2008). The operational environment is characterized by unparalleled ambiguity and uncertainty and military leaders are opposed by clever and adaptive adversaries who learn very quickly (Krawchuk, 2008; Pattee, 2008).

Having recognized this increased need, the United States Army doctrinal manuals now emphasize the importance of having creative and innovative leaders. The Army's new capstone doctrinal publication for operations described the cognitive requirements placed upon commanders as they conduct campaign design, and the manual highlighted the need for a sense of practical creativity (Department of the Army, 2007). That same manual added that once the battle has begun, "commanders draw on experience, intellect, creativity, intuition, and education to make rapid decisions" (p. 98)

The Army's doctrinal manual on command and control of operational forces endorsed what it termed "mission command." By practicing mission command, a leader fosters creativity on the part of subordinate leaders by issuing them broad guidance and providing them the latitude to be flexible, take initiative, and solve their problems in whatever manner they deem most appropriate (Department of the Army, 2003). In fact, creativity was found third on the Army's list of values, attributes, and skills expected of all officers (Department of the Army, 2003).

Echoing this doctrinal call for creativity have been Army officers writing "lessons learned" from their experiences in Iraq and Afghanistan in the professional military journals. As they have found themselves operating in increasingly new and complex environments, they have

reported increasing demand on their creative abilities. Unfortunately, at least in the perceptions of some of the Army's most senior leadership, the current requirements have found many Army officers wanting for the capability of creative thought (Brown, 2007).

Joining the Army in this emphasis, the Marine Corps' doctrine for planning also emphasized the need to "adopt a [planning] method that provides helpful structure without restricting judgment and creativity." (Department of the Navy, 1997, p. 23). It added that the preferred concept of operations for Marine Corps forces, 'maneuver warfare,' "depends on insight and creativity of commanders and the planners who support them." (Department of the Navy, 1997, p. 68) In a recent report to the director of the U.S. Army School of Advanced Military Studies (SAMS), the officer in charge of the planning teams for one of the Marine Expeditionary Forces (MEF) identified the ability for creative thinking as one of the three main requirements for successful operational planners (Bowden, 2008).

In personal communication with the author (January 8, 2008), General M. W. Hagee, former Commandant of the Marine Corps and former commander of I MEF during the planning for Operation Iraqi Freedom, shared his personal appreciation for creativity in the military profession. Hagee stated that to be successful today, a military commander must identify the most creative officers in his command and ensure that they are brought into the planning process and protected by the commander. Of similar mind and believing that the military leaders of today were not in possession of satisfactory levels of creativity, General Krulak issued a solemn warning to the senior leadership of the military. Krulak asserted that the planning and decision-making skills required of contemporary military leaders are of the type not being taught sufficiently in either the institutional or the operational Army (as cited in McCaffrey, 2007).

However, at least one part of the institutional Army has sought to do just that. The U.S. Army SAMS has revised its long-standing mission and curriculum to give greater emphasis to developing in its officers the type of critical and creative thinking skills required to succeed in the modern operating environment (Banach, 2008). SAMS played a critical role in the achievement of the U.S. Army Training and Doctrine Command's (TRADOC) mission of developing the Army's soldier and civilian leaders in order to build a campaign capable expeditionary Army in support of joint warfighting commanders (U.S. Army, 2009b).

As Army officers progress through their careers, completing successful service as company commanders and staff officers in tactical units such as battalions and squadrons, the Army sends them to the Command and General Staff School (CGSS) at Fort Leavenworth, KS. Approximately 1200 officers attend CGSS each year, where they are provided a year-long education in preparation for service as field grade commanders or positions on high-level staffs (U.S. Army, 2009a). Of those approximately 1200 officers, about 100 are selected for an additional year of education at SAMS, where they are groomed for service in designated critical positions, such as the positions of lead planners for the Army's corps and divisions (Wray, 1991). As lead planners, they are responsible for developing all of the tactical and operational plans that guide the actions of the Army's operational units in war. All SAMS graduates are awarded master's degrees in the military arts and sciences upon their graduation. Because the Army is seeking to increase the levels of creativity of its planners and commanders, and because SAMS is the school that provides the operational Army units with the officers who will serve as the lead planners of the operational Army units (Banach, 2008), the researcher selected SAMS as the site to conduct research into the factors that contribute to or impede the creativity of military planners.

Theoretical Basis

This research was designed to identify empirically the hypothesized positive correlation between tolerance of ambiguity and creativity. This hypothesized positive correlation was based upon the convergence of a number of theories. In the field of creativity, the works of Amabile (1983, 1996), including her model of creative problem-solving and componential framework of creativity; Csikszentmihalyi's (1999) systems theory of creativity; and Barron's (1988) model of creative product, creative process, and creative person were all instrumental. Csikszentmihalyi (1999) emphasized the relationships between creative individual, domain, and field. His work laid the theoretical foundation for the identification of precisely who determines which products are creative and which are not. Barron (1988) provided a framework of person, process, and product, which served as a guide to study the relationships between these entities, thereby enabling the study and understanding of the complexities of creative achievement. Amabile's (1983, 1996) theory emphasized the creative product as the focus of analysis, and then branched out to the confluence of traits and abilities that combine to enable an individual to develop such creative products. Amabile's (1996) Consensual Assessment Technique (CAT) provided this study with the instrument with which to measure the officers' creativity. The theories of Amabile (1996), Sternberg and Lubart (1999), and Stoycheva (2008) led the researcher to the identification of tolerance of ambiguity as an individual trait that might be associated strongly with creative achievement.

With regard to tolerance of ambiguity, Frenkel-Brunswik's (1948, 1949) work provided the theoretical foundation. She identified tolerance of ambiguity as a personality variable (1948), and identified the characteristics of individuals who were intolerant of ambiguity (1949). Budner (1962) built upon her work, and his definition of tolerance of ambiguity (AT) and his categories

of ambiguous situations–situations in which there are too few, too many, or conflicting cues–provided additional theoretical foundation for tolerance of ambiguity's relationship to creativity as well as its relevance to the domain of military planning and decision-making. Furnham and Ribchester (1995) provided a meta-analysis of the research conducted into tolerance of ambiguity that was instrumental in the selection of the instrument used to measure it.

The theoretical association between tolerance of ambiguity and creativity has been asserted by many researchers (Amabile, 1983, 1996; Barron & Harrington, 1981; Cropley, 1999a; MacKinnon, 1978; Piirto, 2004; Sternberg, 1999; Stoycheva, 2008). Tegano (1990) asserted that in order to think creatively, an individual must have the desire, willingness, and ability to cope with unstructured and open-ended situations to be effective. Intrinsic motivation has been shown to be a strong contributor to creative achievement (Amabile, 1983, 1996; Hennesey, 2000; Hennessey & Amabile, 1988). Tolerance of ambiguity appeared therefore to be an important contributor to creativity because it "empowers the intrinsically motivated exploration of novel, unusual, or complex stimuli" (Zenasni, Besançon, & Lubart, 2008, p. 6).

Despite the number of works theorizing a relationship, to date there has been little empirical research conducted into the relationship between tolerance of ambiguity and creativity (Albert & Runco, 1999; Barron & Harrington, 1981, El-Murad & West, 2004; Howard, 2006). This research was structured to fill that void in the body of research by empirically exploring the anticipated correlation between tolerance of ambiguity and creativity (Amabile, 1983, 1996; Rogers, 1959; Sternberg, 1988, 1999; Taylor & Barron, 1963; Urban, 2003; Zenasni et al., 2008), specifically in the domain of military planning.

Problem Statement

The United States has been at war, and the leaders of the U.S. Army and the U.S. Marine Corps, the organizations charged with fighting and winning the ground battles of this war, have expressed a need for greater creativity on the part of its officers (Brown, 2007). While many theorists have predicted that a significant positive correlation exists between individuals' levels of tolerance of ambiguity and their creativity (Amabile, 1983, 1996; Rogers, 1959; Sternberg, 1988, 1999; Taylor & Barron, 1963; Urban, 2003; Zenasni et al., 2008), few empirical studies have tested this theoretical correlation, and none of these have been conducted in the domain of military planning (Tegano, 1990; Zenasni et al., 2008). Because creativity is to a large extent domain-specific (Baer, 1998; Sternberg, 1999), it was important for empirical research to be conducted to explore the theoretical relationship between tolerance of ambiguity and creativity, specifically in the domain of military planning.

Purpose Statement

The purpose of this research was to determine if correlations existed between the tolerance of ambiguity (AT) levels of the officers attending SAMS, and the levels of creativity of the military plans they develop.

This research was structured to facilitate the development of a deeper understanding of the factors that enhance or inhibit creativity levels in military commanders and planners and assist the leadership of the U.S. Army SAMS in their efforts to refine their curriculum and selection criteria.

Research Questions

The following questions guided this study:

1. Is there a positive correlation between the levels of tolerance of ambiguity of the officers attending the U.S. Army's School of Advanced Military Studies at Ft. Leavenworth, KS, and the levels of creativity of the military plans they develop? (Primary research question)
2. How effective is Amabile's (1996) Consensual Assessment Technique (CAT) for assessing the level of creativity of military plans? (Secondary research question)

Hypotheses

$H1_A$: There is a positive correlation between the officers' levels of tolerance of ambiguity (AT) and the creativity of the plans they develop.

$H1_0$: There is no correlation between the officers' levels of tolerance of ambiguity (AT) and the creativity of the plans they develop.

$H2_A$: Amabile's Consensual Assessment Technique (CAT) is a reliable instrument for assessing the level of creativity of military plans ($\alpha >$ or $= 0.70$).

$H2_0$: Amabile's Consensual Assessment Technique is not a reliable instrument for assessing the level of creativity of military plans ($\alpha < 0.70$).

Design of the Study

This study was quantitative correlational research that used a non-experimental design (Campbell & Stanley, 1963; Neuman, 2007). In this non-experimental design, no treatments were applied. The reason for the research was to explore the relationship between the level of tolerance of ambiguity and the level of creativity. Specifically, the study described the

relationship between the independent variable (officers' levels of tolerance of ambiguity) and dependant variable (assessed levels of creativity of the military plans they developed). Correlational studies are used to look for relationships between variables (level of tolerance of ambiguity and level of creativity) but they do not establish causation. Variables were measured, but no attempts at manipulating any variables were made (Campbell & Stanley, 1963; Fraenkel & Wallen, 2006; Neuman, 2007).

Procedure

The researcher briefed all officers at the same time with information including (a) the scenario of the problem, (b) the products to be developed by the students, and (c) the time and resources allocated for planning. After the initial briefing, the officers each independently developed their plans. Following completion and submission of the military plans, the officers each completed a pencil and paper test that assessed their levels of tolerance of ambiguity.

Instrumentation

Consensual Assessment Technique (CAT)

The level of the creativity of the operational plans was assessed using the Consensual Assessment Technique (CAT) in which a group of judges familiar with the domain in question each independently assessed the level of creativity of the products (Amabile, 1996). This method had been used previously in research for the assessment of the level of creativity of musical composition (Hickey, 2001), poetry (Picariello, 1992), and artwork (Amabile, 1983). The CAT was grounded in an operational definition of creativity:

> A product or response is creative to the extent that appropriate observers independently agree that it is creative. Appropriate observers are those familiar with the domain in which the product was creative or the response articulated. Thus, creative can be regarded

> as the quality of products or responses judged to be creative by appropriate observers, and it can also be regarded as the process by which something so judged is produced. (Amabile, 1996, p. 33)

Amabile (1996, p. 41) stated that the judges using the CAT, "should all have experience with the domain in question, although the level of experience for all judges need not be identical." The five judges for this research each had experience in the domain, with each of them having previously received formal education and acquired practical experience in the domain of military planning. The judges each recorded the assessments on a Likert-type scale:

1 = Very uncreative

2 = Somewhat uncreative

3 = Neither creative nor uncreative

4 = Somewhat creative

5 = Very creative

Measure of Ambiguity Tolerance (MAT-50)

The participants' level of tolerance of ambiguity (AT) was measured by Norton's (1975) Measure of Ambiguity Tolerance (MAT-50). The MAT-50 is a pencil and paper test with established reliability and validity at measuring an individual's tolerance of ambiguity (Norton, 1975). It is a survey type self-reporting instrument in which subjects responded to various statements such as, "Almost every problem has a solution" by choosing a Likert-type item ranging from YES! to NO! (Norton, 1975). The MAT-50 has been used previously in research investigating the relationship between tolerance of ambiguity and divergent thinking in children and adults (Zenasni, et al., 2008).

Population

The population for this research was all officers attending the School of Advanced Military Studies at Fort Leavenworth, KS (N = 104). All of the military members of the population were field grade officers, grades of 0-4 (Army rank of major) or 0-5 (Army rank of lieutenant colonel), and over 85% were Army officers, with the other being Navy, Marine, or Air Force officers. There was one civilian from the United States Agency for International Development.

Sample

The sample was a convenience sample, consisting of all officers attending SAMS who were present for duty on the day of the study. The sample size was n = 66. The sample differed from the population in that, due to the operational requirements of the Army, some of the officers in the class had graduated early in order to deploy with their new units to Iraq or Afghanistan. Some of the officers in the class were on temporary duty at other posts, and a few were unavailable due to academic necessities. All participants were current students, and all had been deployed to the combat theaters of either Iraq or Afghanistan during their previous assignments. The students at SAMS were organized into seven seminars, each with a colonel in charge as their seminar leader. The complete demographics of the sample can be seen in Appendix A. The officers graduating early were not selected due to any specific trait or ability, and there appeared to be no reason to believe their absence reduced the representativeness of the sample.

Significance of the Research

This research was significant in that it could potentially serve as a first step in the Army's quest to determine the factors that enhance and those that inhibit creative achievement on the

part of military commanders and planners. Although much research has been done into the creativity of products, there has been no research to date specifically in the domain of military planning. This research was important because "certain components may operate as facilitators in certain domains but inhibit creativity in others" (Batey & Furnham, 2006, p. 360).

As the U.S. is presently engaged in what has been termed "The Long War" (Sullivan, 2006, p. 1), against a determined and resourceful foe, research of this type has taken on an new level of importance. This research also sought to identify the appropriateness of using Amabile's Consensual Assessment Test (CAT) as a means of assessing the creativity of military plans. Previously, despite the military's stated objective of increasing the levels of creativity of its leaders, there has been no agreed upon means for assessing the creativity of military plans. Most importantly, this study sought to confirm a theoretical correlation between officers' levels of tolerance of ambiguity and their levels of creativity (Amabile, 1983, 1996; Rogers, 1959; Sternberg, 1988, 1999; Taylor & Barron, 1963; Urban, 2003; Zenasni et al., 2008). The relationship has been found empirically in some domains and studies (Stoycheva, 2008; Zenasni et al., 2008), but not in others (Basadur, Runco, &Vega, 2000; Katz, 2002). The knowledge gained from this study could assist the Army, and SAMS in particular, in efforts to both identify their current most highly creative officers and to develop educational programs to foster the creativity levels of all of their officers.

Limitations of the Research

The following limitations apply to this research. The sample size was smaller than desired under ideal conditions. Due to the immediate needs of the Army operational forces, a number of the SAMS students had graduated ahead of schedule in order to deploy to combat with their joining units, and they were unavailable to participate in this study. Second, as with all

correlational research, results of this study could show existing associations between the variables in question, but could not establish a causal relationship between them.

Data Analysis

The statistical software package, SPSS, was used for all statistical analyses on the data set. Inter-rater reliability of the judges on the consensual assessment technique was determined by the computation of Cronbach's alpha, with a minimum level of acceptability of 0.7 (Field, 2005). Descriptive statistics were used to analyze the variance, standard deviation, and normality of distribution of the tolerance of ambiguity and the creativity scores. SSPS was used to assess the internal reliability of the MAT-50 test of tolerance of ambiguity, as determined by Cronbach's alpha (Field, 2005). Finally, analysis of correlation relationships between the creativity scores of the plans and the tolerance of ambiguity (AT) scores of the planners was conducted following the method used by Stoycheva (2008), in which the independent variable (AT) was used to dichotomize the sample into two groups: those with high levels of AT (HAT) and those with low levels of AT (LAT). An independent *t* test was then used to determine if the mean creativity score of the HAT group was significantly higher than that of the LAT group.

Definition of Terms

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

Ambiguity. The condition characterized by either imprecision, uncertainty, or vagueness of meaning or the presence of two or more meanings (Werman, 1979).

Ambiguity tolerance (AT). The way an individual or group perceives and processes information about ambiguous situations or stimuli when confronted by an array of unfamiliar, complex, or incongruent clues (Furnham & Ribchester, 1995).

Ambiguous Situations. Any situation that fits one of three categories: Completely new situations in which the individual has no experience and therefore finds no familiar cues, overly complex situations in which there are too many cues for the individual to process, and contradictory situations in which the available cues lead to different and perhaps mutually exclusive structures (Budner, 1962).

Cognitive set. An individual's predisposition or readiness to engage in a particular thought process (Thompson, 1966).

Creativity. "The ability or quality displayed when solving hitherto unsolved problems, when developing novel solutions to problems others have solved differently, or when developing original and novel (at least to the originator) products which are found to be appropriate and of some value" (Parkhurst, 1999, p. 99).

Domain-relevant skills. Knowledge and skills that contribute to creative performance in a given domain, including factual knowledge, technical skills, and special talents (Amabile, 1996).

Intolerance. A person is considered increasingly intolerant of a stimulus as he interprets it increasingly as a source of psychological discomfort or threat (Norton, 1975).

Intolerance of ambiguity. The tendency to perceive or interpret ambiguous situations as sources of threat (Budner, 1962).

Military planning. The art and science of envisioning a desired future condition and developing and laying out effective ways of bringing it about (Department of the Navy, 1997).

Perceptual set. An individual's predisposition and readiness to perceive a particular stimulus (Thompson, 1966).

Tolerance of ambiguity. The tendency to view ambiguous situations as desirable or rewarding.

Summary

In summary, United States military officers face increasingly complex and uncertain situations. Military planners must be able to thrive in such environments and to develop plans that are unpredictable to their adversaries. In order to do so, military planners must be highly creative individuals. For this to be possible, the faculty of SAMS, the institution that selects and educates the officers that go on to become the lead planners for the Army's operational forces, must develop an understanding of the concept of creativity in the domain of military planning. They must learn which factors enhance the creativity levels of military planners, and which inhibit the same. They must develop understanding of which of these factors are stable and which are dependent upon the specific context of the situation. They must gain an appreciation for which aspects of creativity are the results of nature and which are the result of nurture, thereby enabling the informed refinement of selection criteria to address the former and the development of appropriate curriculum to address the latter. These are herculean tasks by any measure, but by exploring the relationships between tolerance of ambiguity and creativity in the domain of military planning, this research could assist the Army in the initial stages of this important effort.

CHAPTER 2 - LITERATURE REVIEW

Introduction

> It is not enough to recognize creative talent after it has come to expression….It is our task as psychologists and educators either through our insights or through the use of validated predictors to discover talent when it is still potential and to provide the kind of social climate and intellectual environment which will facilitate its development and expression. D.W. Mackinnon, (1962)

"I will be damned if will permit the U.S. Army, its institutions, its doctrine, and its traditions to be destroyed just to win this lousy war." Anonymous U.S. Army General.

This chapter reviews the available relevant literature regarding the relationship between creativity and tolerance of ambiguity. The volume of works in this area was overwhelming. In his presidential speech to the American Psychological Association (APA), J.P. Guilford (1950) noted that for the previous 25 years, less than 0.2% of the books and articles indexed in *Psychological Abstracts* dealt with creativity. Since that time however, the amount of research into the concept of creativity has exploded. In addition to the many books published on the subject, there are now two peer-reviewed journals dedicated solely to the field of creativity research (Clark, 2008). Illustrating the high number of researchers now conducting work in this field, the *Encyclopedia of Creativity* (Runco & Pritzker, 1999) is over 1,500 pages long and contains over 190 different sections, each authored by a scholar in the field. This trend shows no sign of slowing, with meaningful research in the field of creativity now published literally every month.

Similarly, since Else Frenkel-Brunswik first published her research in 1948 and 1949 identifying tolerance of ambiguity as a personality variable, a large amount of research has been

devoted to that concept and its applications in a wide variety of fields (Bochner, 1965; Furnham & Ribchester, 1995). The concept of tolerance of ambiguity and its relationship with creativity has been the subject of comment and study by such renowned researchers as Guilford (1950, 1970), Gardner (1988), Mackinnon (1962), and Rodgers (1959, 1970). More recently, the 29th International Congress of Psychology 2008 symposium, held in Berlin, Germany, dedicated a special session to "Tolerance for Ambiguity, Creativity, and Personality" (Stoycheva, 2008).

To provide an organized summary and review of this extensive body of knowledge, this chapter begins with exploration of the definition of creativity, explaining why creativity is important to the domain of military planning and decision-making. The chapter explores the major approaches to the study of creativity catalogued in Sternberg's (1999) *Handbook of Creativity* and concludes with selection of the approaches used in the current research.

The chapter next uses Barron's (1988) framework for understanding creativity of: (a) the creative product, (b) the creative process, (c) and the creative person. To the greatest extent possible, a chronological order is maintained in each section. The literature regarding the concept of creativity is reviewed in increasing depth as the topic is refined, ultimately arriving at the hypothesized relationship between an individual's tolerance of ambiguity and his or her level of creativity. The scope then broadens and examines the concepts of perception, categorization, and ambiguity. Such exploration follows a similar progression with the concept of tolerance of ambiguity, exploring first its definition and then its concept. This section provides a brief review of the literature surrounding the cognitive aspects of ambiguity, including the prevailing theories of how these influence the mental processes of perception, idea generation, and idea evaluation. The chapter concludes by summarizing the significant theoretical and empirical works that

provide the rationale for the hypothesized relationship between tolerance of ambiguity and creativity.

Creativity

Creativity has been defined in many different ways throughout the years. Cropley (1972, p. 119) lamented, "One of the key problems in studying the development of creative abilities is centered on the lack of consensus as to just what creativity is." More recently, Majaro (1988, p. 3) stated that while conducting his research, he “collected as many as eighty different definitions” for creativity. The curators preparing an exhibition to commemorate the awarding of the first Nobel Prize reportedly collected more than 100 descriptions and definitions of creativity, 40 of which were ultimately used in the display (Smith, 2005). Davis (1992) remarked, “There are about as many definitions, theories, and ideas about creativity as there are people who have set their ideas on paper” (p. 38).

The existence of so many varying definitions of creativity is probably partly due to the fact that creativity is a very complex phenomenon (Piirto, 2004). Torrance (1988) went so far as to say, “Creativity defies precise definition” (p. 43). Taylor (1975) stated, "Definitions of creativity are often misleading; they say too much and too little" (p. 2). Cropley (1999a) asserted that for this reason, creativity could be defined only locally, in particular areas or domains. Because this research was concerned with creativity expressed in the domain of military planning and decision-making, creativity meaning in this domain was explored.

According to Marine Corps Doctrinal Publication 5 (Department of the Navy, 1997), planning is the art and science of envisioning a desired future, laying out the actions required to bring about this future condition, and communicating them to the appropriate individuals and organizations. Simon’s (2001) concept of creativity stated that thought is creative when it

produces something that is both novel and valuable. Smith (2005, p. 294) added, "Novelty can only be defined in relation to what is not novel; that is, what is conventional and acquiescent." Further, as Batey and Furnham (2006, p. 359) asserted, "There is the issue of whether any person can produce something that is entirely novel; instead, the requirement of surprise may prove a fitting criteria." This emphasis fit nicely with a military application as the military sought creative plans not merely for the sake of novelty, but rather for the effect of surprise they are expected to have on the opposition. Creativity could produce effective surprise in two different ways: either through the new and novel application of existing principles or by developing completely new principles (Cropley, 1999a).

Weisberg (1988, 2006) asserted that novelty will come into play only if the individual both perceives some inadequacy with the standard or accepted method or product and can find a way to overcome the perceived inadequacy. Novelty, however, is only part of the definition. Parkhurst's (1999) definition of creativity was therefore chosen for this research:

> The ability or quality displayed when solving hitherto unsolved problems, when developing novel solutions to problems others have solved differently, or when developing original and novel (at least to the originator) products which are found to be appropriate and of some value (p. 99).

This definition was chosen due to the research's focus on the creativity of military operational plans, which first must provide a workable solution to a complex problem. As Barron (1988, p. 76) said of creative works, "We celebrate the originality, but take notice only if it's accompanied by adequacy in meeting some need." El-Murad and West (2004, p. 191) stated, "Originality is a required but insufficient condition for creativity." Simon (2001) and others included the requirement for a creative act to be valuable in order to remove from consideration meaningless fantasy and the *word salad* of the schizophrenic (Sternberg, 1999). Likewise,

military operational plans that would not enable the designing unit to achieve their designated objectives are of no value, regardless of their level of novelty.

The requirement for something to be of value for it to be creative brought up the obvious questions of how the value of a new idea or concept could be determined and who could determine it (Amabile, 1996; Piirto, 2004). Csikszentmihalyi (1999) added that an idea's creativity therefore depends less on its own attributes than on the effect that it has upon others and proposed a systems theory of creativity that included individuals, domains, and fields. Creativity occurred, Csikszentmihalyi asserted, when an individual produces a novel variation in a domain that is accepted and found to be of value by a field.

This research focused on the creativity of individuals in the domain of military planning and decision-making. In the domain of military planning, the *field* in Csikszentmihalyi's system would be the unit commander who made the decision to accept or reject the proposed plan, along with his staff and other officers whose input and counsel he sought and valued. Regardless of the merits of a given military plan by any metric, the plan would be adopted and implemented only if the commander *accepted it and found value in it.* The doctrinal metrics by which a commander assessed the value or adequacy of a military plan were (a) feasibility: the degree to which the unit assigned could actually perform the operation as set forth in the plan with the resources allocated, (b) suitability: the degree to which the unit's successful conduct of the operation as set forth in the plan accomplished the requirements dictated by the unit's higher headquarters, and (c) acceptability: the degree to which the benefits of performing the operation outweighed the costs (Department of the Army, 2005). In military doctrine, the evaluation of the plans using these three criteria was referred to as the FAS test (Department of the Army, 2005).

One challenging aspect of applying the FAS test was the requirement for the evaluator to envision not just what his own forces would do, but also what the forces opposing him might do, as well as how the two forces might interact (Department of the Army, 2005). Schelling (1960) referred to this as decision-making in competition. The two forces not only might conduct operations in the same area at the same time, but they would each actively seek to prevent the other from accomplishing their respective objectives. Both commanders must therefore weigh their objectives and potential actions against what they believe to be those of their enemy.

In such competitive environments, the decision-maker is faced with what Luttwak (1987, p. 16) termed "the paradoxical logic of strategy," which dictates that due to the advantages offered by the element of surprise, the commander's worst option might well become his best option–precisely because it was his worst. So, the uncreative commander who attacked in a predictable manner, straight down the most-direct route available, as Lord Cardigan did at the Battle of Balaclava in 1854 (Sweetman, 1990), tended to be much less successful than the creative commander who attacked at an unexpected time or place, like General Washington did at the Battle of Trenton (Ketchum, 1999).

The Study of Creativity

Creativity is a very complex phenomenon (Piirto, 2004). To assist in a systematic examination of such a large body of knowledge of such a complex nature, this section examines Sternberg's (1999) review of the seven conceptual approaches of the study of creativity. Brief descriptions of these approaches follow.

1. The mystical approach, which stated that creativity is the result of divine intervention.

2. The pragmatic approach, which focused on the ways and means to increase people's applied creativity.
3. The psychodynamic approach, which believed that creativity is the result of ongoing tensions between "conscious reality and subconscious drives" (Sternberg, 1999, p. 6).
4. The psychometric approach, pioneered by the work of men such as Guilford and Torrance, that believed that creativity exists to various degrees in all people, and that the best way to gain an in-depth understanding of creativity was through the measurement of creative abilities through controlled tests.
5. The cognitive approach, which asserted that the best way to study creativity is through gain an understanding of the underlying mental processes and representations.
6. The social-personality approach, which sought understanding of the personality and motivational variables which, combined with the elements of the socio-cultural environment facilitate creative production.
7. The confluence approach, which asserted that creative behavior is the result of a confluence of many factors (Sternberg, 1999).

Mystical Approach

The first, the mystical approach, viewed creativity as a spiritual process. Followers of the mystical approach credited creative achievement to some otherworldly entity (Spentzou & Fowler, 2002). According to Plato (as cited in Spentzou, 2002, p. 85), the artist creates poetry "precisely when he becomes possessed and out of his senses and his mind dwells in him no more." Kipling once credited his work to a demon who resided in his pen (Sternberg, 1999). For

one using this approach, creativity was "beyond measurement and even comprehension" (Batey & Furnham, 2006, p. 360). If the source of creativity were external to man or mankind, then the most that could be achieved through its study would be an acknowledgment and greater appreciation. Consequently, the mystical approach was of no use for efforts to understand and promote creativity in military officers.

Pragmatic Approach

The second of Sternberg's approaches was the pragmatic approach. Followers of this approach sought to find marketable ways to enhance the creativity of others, without first developing an accurate understanding of the underlying concepts (Sternberg, 1999). Sternberg highlighted DeBono's concepts, such as the six thinking hats, and Gordon's synectics as a few of the more notable commercial ideas for increasing someone's creativity. He was critical of these concepts, citing their lack of serious theoretical basis as well as of supporting empirical evidence. While he acknowledged, "Of course, techniques can work in the absence of psychological theory or validation," (p. 6), the clear implication was that absent any predicting theory and any empirical evidence, any concept remained dubious, at best.

Pratkanis (Personal communication, June 23, 2009) added that there well might be two very different types of creativity: one that enabled an individual to excel at small tasks, such as finding the maximum number of new ways to fold a paper hat, and another that enabled a person to innovate and find creative solutions to problems faced in real life. While there may have been some social benefits of conducting the creativity seminars DeBono advocated in the workplace, the benefits likely ended there. Sternberg's critique of the pragmatic approach was compelling: the severity of the consequences of the actions and the culture in which the officers must perform

obliged decision makers to turn away from thinking hats and other approaches that appeared as gimmickry.

Psychodynamic Approach

Sternberg's third approach to the study of creativity was the psychodynamic approach. The underlying principle of this approach was that creativity was the result of the tensions experienced between an individual's conscious reality and their unconscious drives. Freud asserted that artists and writers produced creative works as a means of expressing their unconscious desires for things such as money and fame in a socially acceptable way (Sternberg, 1999). Advocates of the psychodynamic approach have continued to build upon its basis, adding concepts such as the distinction between the conscious and the preconscious modes of thought (Kris, 1952). Critics of the approach have labeled it reductionist and detrimental to the efforts to understand the true nature of creative thought (Lakatos, 1970). For the purposes of this research, the psychodynamic approach was deemed to be of limited value. If the source of all creative thought were subconscious desire, little could be done to facilitate the development of creative talents of military officers.

Psychometric Approach

Sternberg's next approach was the psychometric approach. Guilford was recognized as the pioneer of this approach, in which the various levels and aspects of the creativity were studied and measured predominantly using pencil and paper tests (Sternberg, 1999). The use of this approach facilitated a significant expansion of research into creativity, mainly because of increased convenience. Everyday subjects were relatively easy to find, and paper and pencil tests were relatively easy to administer (Amabile, 1983; Davis, 1992). Guilford's initial tests were

built upon by many including Torrance, whose Torrance Tests of Creative Thinking (TTCT) are still widely used (Amabile, 1989; Barron & Harrington, 1981; Davis, 1992; Sternberg, 1999).

Barron and Harrington (1981) proposed that the widespread use of psychometric tests of creativity have led to the forced distinction in the operational definitions of creativity. On the one hand was the socially recognized achievement in which "there are novel products to which one can point as evidence, such as inventions, theories, published writings, paintings and sculptures and films; laws; institutions; medical and surgical treatments, and so on" (1981, p. 442). On the other was the "ability manifested by performance in critical trials, such as tests, contests, etc., in which one individual can be compared with another on a precisely defined scale" (1981, p. 442). Thus, while pencil and paper psychometric tests offered convenience and the ability to control for variables, they have been significantly criticized for their questionable relevance to the real world (Amabile, 1996; Barron & Harrington, 1981).

Social-Personality Approach

In contrast to the psychometric approach, the social-personality approach sought to understand creativity as expressed in the real world. As the name implied, followers of this approach, including Barron (1953, 1988) and Amabile (1983), noted that creative people tended to share specific personality traits. Through correlational research in various domains, a set of traits believed to foster creativity in individuals emerged, including risk-taking, self-confidence, and tolerance of ambiguity (Amabile, 1983; Barron & Harrington, 1981; Batey & Furnham, 2006; Parnes, 1992). The social-personality approach has also provided valuable understanding into the relationship between motivation and creativity (Amabile, 1983; Golann, 1963; Hennessey & Amabile, 1988). The social-personality approach has direct applicability to the

present research. The next approach, however, adds important concepts to the strength of the social-personality approach.

Confluence Approach

The final approach Sternberg (1999) listed was the confluence approach, which asserted that for creativity to occur, multiple factors and components must have been present in some combination. Amabile (1983, 1996) described creativity as the confluence of intrinsic motivation, domain-relevant knowledge and abilities, and creativity-relevant skills (Figure 1). Csikszentmihalyi's (1997, 1998) systems perspective of creativity in which the individual, the field, and the domain must all have come together for creativity to have occurred, was another excellent example of the confluence approach. According to Csikszentmihalyi (1997), creativity occurred when an individual developed something new in a given domain that was found valuable by the field. Another example of the confluence approach was Sternberg and Lubart's (1995) investment theory, which used the metaphor of financial investing to explain the creative process. In this model, creativity occurred when an individual "buys low and sells high in the realm of ideas" (Sternberg & Lubart, 1999, p. 10).

Confluence Theory in the Current Study

In an attempt to maintain clarity while systematically exploring the literature surrounding creativity and its relationship with tolerance of ambiguity, this research utilized Barron's (1988) framework of the three P's–the creative product, the creative process, and the creative person—as the means for organizing the literature. Although the review addresses these three aspects–the creative person, product, and process–sequentially, the three aspects of Barron's framework are interrelated (Barron, 1988; Basadur et al., 2000; Kaufman & Sternberg, 2007). The creative person uses the creative process to develop creative products (Kaufman & Sternberg, 2007).

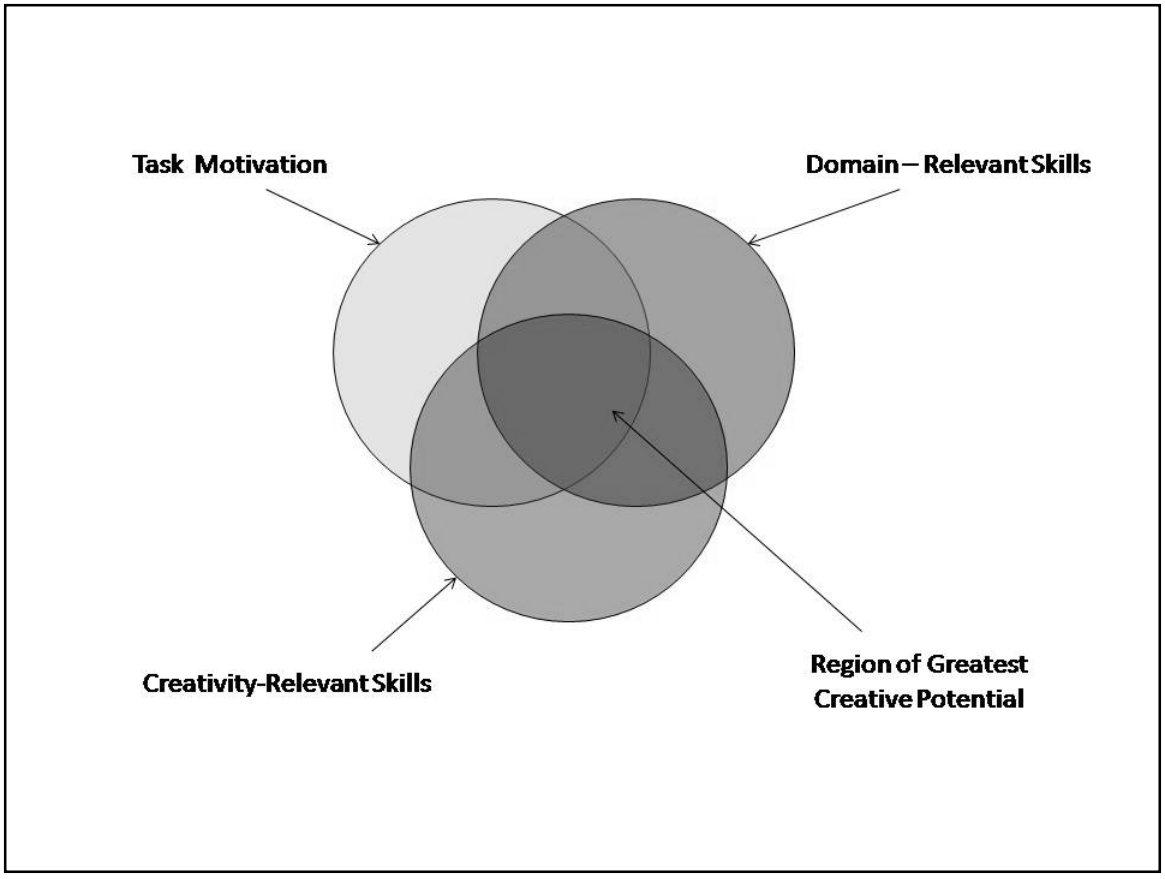

Figure 1. Model of creativity based on elements from Amabile (1996).
Creative achievement occurs at the confluence of domain-relevant skills, creativity-relevant skills, and task motivation.

Note. From *Creativity in Context* by Amabile, 1996, Boulder, CO, Westview Press.

The Army expressed the greatest concern with the level of creativity of their officers (persons), but ultimately they cared about the creativity of their officers because creative officers tended to develop creative plans (products). However, to increase the creativity of their plans in war, they had first to identify their most creative officers and enhance their inherent creative abilities through training and education, and ensure that the human resources policies were in place so that they were assigned to the appropriate leadership and planning assignments. Finally, in order to identify the most highly creative officers, they had to understand the creative process. Mackinnon's (1978) straightforward logic stated the situation well: a creative person is one who develops creative products.

Therefore, the next section reviews the literature surrounding the creativity of products first. Following Amabile's (1983, 1996) logic of identifying creative individuals through their development of creative products, the literature surrounding creative individuals is reviewed. The literature describing the traits and characteristics of the creative individual (Amabile, 1996; Eysenck,1993) is next reviewed in order to develop hypotheses regarding the correlation between the officers' personality traits in question and their creative achievement in the military planning domain.

Not all researchers agreed with this approach. Plucker and Beghetto (2004) provided a dissenting viewpoint and argued that the only legitimate focus of creativity research is on creative achievement. According to the logic they put forward, everyone has some level of creative potential. However, creative potential is no guarantee of creative achievement (Guilford, 1950; Plucker & Beghetto, 2004). Their argument concluded with the thought that creative achievers obviously possess creative potential, but the converse is not true (Plucker & Beghetto, 2004).

Weisberg (1988) seemed to support Plucker and Beghetto by asserting that it is neither necessary nor possible to increase an individual's capacity for creativity. Barron (1988), however, provided compelling counter to Plucker and Beghetto's logic by lamenting the tragedy of creative talent left unidentified, ignored, undeveloped, or even squelched. While acknowledging their dissent and accepting their point that some aspects of creativity are probably innate and consequently cannot be altered significantly, the present research adopted Barron's (1988) position and was structured to find the factors that could be used systematically to nurture the latent creative talents in Army officers.

Creative Product Analysis

"The starting point, indeed the bedrock of all studies of creativity, is an analysis of creative products" (Mackinnon, 1978, p. 187). It is the analysis of creative products that enabled creativity research to move beyond the theoretical and into the practical and useful (Sternberg, 1999). Most of the research surrounding creative products dealt with the person who created them and the processes they used to do so. Torrance and Goff (1989) identified over 200 published instruments used to measure creativity, although most of them assessed the creativity of the person through traits or mental abilities instead of through the products the person developed. Most of the research that addressed creative products per se tended to explore the techniques by which the creativity of products could be assessed (Sternberg, 1999). It was telling that Barron (1969) titled one of his more significant books, *Creative Person and Creative Process*. The "creative product" was conspicuous by its absence from the title. This section therefore examines the literature surrounding the techniques and instruments for assessing the creativity of products.

Taylor's (1975, p. 313) Creative Product Inventory was an example of an instrument designed to enable "a qualitative analysis of the creative attributes of the product itself and the effects of the product." The Creative Product Inventory (CPI) had seven criteria against which any product could be assessed for creativity. The seven criteria included

1. Generation: The degree to which it generated or produced new ideas.
2. Reformulation: The extent to which it altered or restructured the problem.
3. Originality: The degree to which the product was unique or statistically infrequent.
4. Relevancy: The extent to which the product was appropriate to the problem.

5. Hedonics: The degree to which the product was attractive.
6. Complexity: The range, depth, scope, or intricacy of the product.
7. Condensation: The degree to which the product simplified, unified, and integrated.

The product was evaluated for its degree of effective creativeness against each of these seven criteria, along the following four dimensions:

1. As a concrete product,
2. as related to the problem,
3. as related to the field,
4. for its out-of-field effects (Taylor, 1975).

The resultant matrix of seven criteria each judged across four dimensions became quite unwieldy. However, the CPI was only one of the instruments designed to assess product creativity. The Creative Product Semantic Scale (CPSS), for example, was based upon the three dimensions of novelty, resolution, and elaboration and synthesis (Cropley, 2000). These three dimensions contained distinct facets (Besemer, 1998). The dimension of novelty included the facets of originality and surprise. The dimension of resolution included the facets of logical, useful, valuable, and understandable (Besemer, 1998). The dimension of elaboration and synthesis included the facets of organic, well crafted, and elegant (Besemer, 1998).

Along each of these facets, the evaluator assessed the product using subscales of adjective pairs on a 7-point Likert-type scale (Besemer, 1998; Dacey, 1989). The evaluations were subjective, but the CPSS provided structure to ensure the judges looked at the same thing (Sternberg, 1999). In its attempt to be thorough, the CPSS, with its 55 items in three dimensions and 11 subscales, could easily become too confusing and unmanageable (White & Smith, 2001).

In contrast to the CPSS, the Consensual Assessment Technique (CAT) (Amabile, 1983, 1996) was a technique for assessing the creativity of products that relied entirely on the subjective assessment of judges. The CAT was based upon the constructivist assumption that individuals who were familiar with a given domain could independently identify creative products developed in that domain (Amabile, 1996). That technique was used in the present study, and is addressed in detail in chapter 3 of this report.

Having discussed the creative product, the next section examines the literature regarding the creative process. Although there are many theories about the creative process, almost every source included reference to Wallas's (1926) four-stage process of creative thought as the concept that set the theoretical groundwork that all have since followed (Lubart, 2000). For this reason, Wallas's (1926) four-stage creative process is used in the next section as the point of departure for discussion.

The Creative Process

Wallas (1970) proposed that the process of creative thought included four stages: preparation, incubation, illumination, and verification. Although Wallas listed and discussed the stages in sequence, and labeled them collectively as a process, he emphasized the non-linearity of the thought process. "And it must be remembered that much very important thinking… resembles musical composition in that the stages leading to success are not very easily fit into a 'problem and solution' scheme" (Wallas, 1970, p. 92).

In the preparation stage, the individual becomes aware of a problem and tries all known solutions to the problem. If none of the known and immediately available solutions results in success, the individual begins to explore new possibilities. During this stage, the individual conducts research and gathers information relevant to the problem. "This stage is typically

characterized by periods of effortful, often frustrating, work on the problem, generally with little progress" (Reisberg, 2006, p. 501). Of course, if one of the known solutions works and solves the problem, the individual ceases the process and moves on. In such an instance, the problem is solved, but the accomplishment is not considered a creative achievement.

Weisberg (1988) reminded that individuals tend to develop creative solutions only after known solutions have been found inadequate. This concept is further supported by the logic of economization of cognitive effort, which dictates that individuals tend to seek to minimize the expenditure of cognitive energy (Ashcraft, 2006). The difficulty facing the military planner therefore was the challenge of knowing in advance when the known solutions represented by established military doctrine and practice would work and when they would be inadequate.

It was easy in hindsight to see when accepted doctrinal methods were inappropriate, such as the well-documented failures of the repeated frontal assaults ordered by the generals commanding the trench-bound armies along the western front during WWI (Tuchman, 1962). However, the challenge to SAMS was to provide officers an education enabling them to assess the appropriateness of accepted means and methods prior to actually carrying them out. If a military planner sought innovative methods only after all doctrinal methods had been proven unsuccessful, the cost in lives and material would likely be unacceptable. This issue is again discussed, albeit from a different perspective, in the upcoming section on ambiguity, perseveration, and cognitive rigidity.

According to Wallas (1970), the incubation stage followed the preparation stage in the creative process, with the illumination stage following next. During the incubation stage, the individual ceased actively, consciously, attempting to solve the problem and began to do something else. The illumination occurred when the individual suddenly became aware of a

potential solution to the problem (Wallas, 1970). For the sake of ease of understanding, these two stages are discussed together, for it was the arrival of the illumination that ended the incubation. Guilford (1975, p. 55) described the incubation stage as, "making observed progress during times when one is not actively pursuing solutions." Ghiselin (1963, p. 356) described the incubation period, following the preparation and leading to the illumination, saying "[the preparation's] value lay in its consequences. For always, after a period of quiescence that followed this apparently useless work, the obscurity was dispersed, the difficulty was removed, by the spontaneous appearance of fresh insight."

Guilford (1975, p. 55) stated, "I doubt that any recognized creative person would deny the fact that incubation occurs, and is frequently helpful." Segal (2004) found that taking a break greatly assisted individuals in solving insight problems. Poincaré (1955) described awakening in the middle of the night with the answer to mathematical problems that he had been previously unable to solve. Wolfgang Amadeus Mozart (quoted in Sessions, 1952, p. 45) described his experiences of the incubation and illumination stages during his musical composing efforts as, "What a delight this is, I cannot tell! All this inventing, this producing, takes place in a pleasing, lively dream." Parnes (2007) referred to the illumination stage as the "aha experience," and stated, "This new and relevant connection or new and harmonious connection often 'just happens'" (p. 226). The gist of the incubation phase appears to be that the unconscious mind continues to attempt to solve the problems after the conscious mind has been directed elsewhere (Arieti, 1976).

However, there were voices of dissent in the field of the study of creativity. In his book titled tellingly, *Creativity: Genius and Other Myths*, Weisberg (1986, p. 30) stated that the concept of unconscious thinking and incubation is a myth because, "a number of laboratory

studies have produced only very weak evidence for unconscious processes in thinking, even though they were designed to give adequate opportunity for incubation to occur." In fact, Reisberg (2006, p. 501) asserted, "Most modern psychologists are highly skeptical about Wallas's proposals." It seemed that those who denied the existence of the unconscious thought and incubation stage, as Wallas (1970) postulated, did not deny the occurrence of individuals having suddenly become aware of the solution to problems after having ceased to actively work on them. Rather they developed alternative hypotheses to explain the phenomenon, such as the break from the effort enabled the individuals to recover from fatigue, or that they encountered a clue of which they had previously been unaware (Reisberg, 2006; Weisberg, 1986).

While as yet there was no consensus in the field, many of the individuals recognized as being highly creative authors, mathematicians, engineers, statesman, artists, and poets (Ghiselin, 1952) had all described the phenomenon of incubation and illumination. Dodds, Ward, and Smith (2003) recently found what they believe to be empirical support of incubation and evidence that supported a hypothesis that the length of time of incubation was important to the process. The significant issues facing those interested in enhancing the creative achievements of military planners and commanders therefore seemed to include how to find the individuals capable of achieving the illumination that successfully ends the incubation, and how to determine the length of incubation that maximizes the chances of creative ideation while still fitting into the unit's planning tempo. The participants in this research were not given a specific incubation period during their planning because they will rarely have the luxury of extra time for incubation when planning operations in combat.

The final stage of the creative process was the verification stage in which the individual mentally thought through the new idea or solution to determine if it would have worked. As

Dacey (1989, p. 86) stated, it is the verification stage where "the idea must be tested against the cold reality of fact." He added, "Verification is really the most important aspect of creativity, despite the romantic reputation given to incubation and illumination" (1989, p. 86).

Amabile (1996, p. 119) called this stage "Response validation and communication." She stated, "Using domain-relevant techniques of analysis, the response possibility is tested for correctness or appropriateness against the knowledge and assessment criteria included within domain-relevant skills" (1986, p. 96). The verification stage may well have multiple stages, depending on the degree to which the individual could have implemented the solution on his or her own. If the individual had to convince others to implement the solution, in essence, the verification stage would include not just his or her internal verification, but then communication of the merits of the solution to those whose acceptance was required for implementation. For this reason, Sternberg (1999) included the ability to communicate effectively and other practical skills as requirements for creative achievement.

During the process of verification, if the individual found that the solution was not appropriate or would not work, the individual would revert to one of the earlier stages of the creative process (Wallas, 1970). Amabile (1996) added in her model that if the individual rejected the potential response during the verification stage, the level of task motivation would determine if the individual would revert to an earlier stage or if the person instead would abandon the problem altogether. As seen in Figure 2, unlike extrinsic motivation, which may a positive or negative impact on an individual's creativity, intrinsic motivation has been shown consistently to have a strong positive correlation with creativity (Hennessey & Amabile, 1983, 1999). This situation–when the potential solution was determined to be unusable during the verification stage of the creative process—could explain a large part of the significant impact of

intrinsic motivation. Absent a sufficiently high degree of intrinsic motivation, the would-be problem-solver may have given up after the initial setback. Based upon Roe's finding (1952) that the willingness to work hard was the single most important factor contributing to the creative achievement of scientists, intrinsic task motivation may have been critical to an individual continuing to attempt to solve the problem if the initial ideas were not found sufficient.

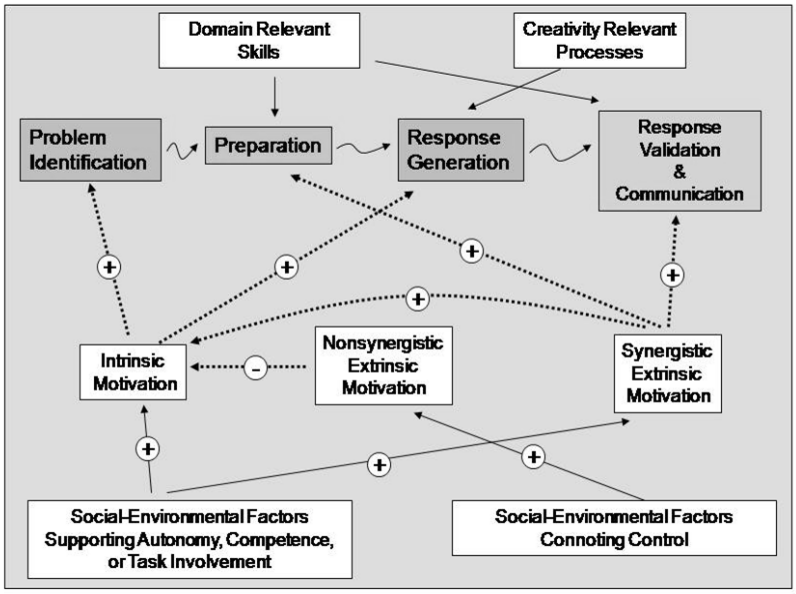

Figure 2. Amabile's (1996) componential model of creativity.
Amabile's (1996) model shows how the components of domain relevant skills, creativity relevant skills, and task motivation impact creativity at each step of the creative problem-solving process. Task motivation is broken down into intrinsic and extrinsic motivation. Intrinsic motivation promotes creativity, both in the problem identification and the response generation steps, while extrinsic motivation can either promote or hinder creativity.

Note. From *Creativity in Context* by Amabile, 1996, Boulder, CO, Westview Press. Adapted with permission of the author.

This process–preparation, incubation, illumination, verification–has been simplified by some to a process of analysis and synthesis of thought (Sternberg, 1999). During the analysis, the individual "disassembles a whole into its parts, separating out from one another the elements of a problem" (MacKinnon, 1978, p. 49). The synthetic thought includes the acts of redefining

problems, finding patterns, and generating ideas (Sternberg & O'Hara, 1999). During creative thought, the individual must use both in an interactive manner. Davis (1992) called these two types of thinking divergent and convergent thought. He advocated a slightly different problem-solving process with the five steps of fact-finding: problem-finding, idea-finding, solution-finding, and acceptance-finding.

Davis (1992) stated that an individual must have used both convergent and divergent thought during each step of the process. Basadur and Finkbeiner (1985) referred to this process as ideation-evaluation, where ideation was the use of divergent thinking to generate the maximum number of ideas possible without judging, evaluating, or censoring them in any way. The evaluation step would be the use of convergent thinking to evaluate all of the ideas developed to determine which are feasible.

Convergent thinking is oriented towards finding the correct or single best answer (Cropley, 1999a). Conversely, divergent thinking is oriented at developing multiple, often new or unusual, ideas or answers (Cropley, 1999a). All individuals use these types of thinking, virtually every day (Reisberg, 2006). However, it appears that certain individuals tend to come up with creative ideas and new solutions to problems continually while others do not (Feist, 1999). The next section reviews the literature regarding the creative person in an attempt to understand the reasons for the concept. In the process, the next section serves to establish the basis for the researcher's hypothesis and establish where the present research fits into the body of knowledge surrounding individual differences in creativity.

The Creative Person

Amabile's Component Framework of Creativity

According to Weisberg (2006, p. 60), "The creative process or creative thinking comprises the thought processes that bring about products that are novel.…A creative person is one that produces such products." Weisberg's statement was both straightforward and intuitive, but it also offered little in the way of understanding what made a creative person creative. In order to gain such an understanding, this researcher started with Amabile's confluence theory. According to Amabile (1983, 1996), an individual's level of creative achievement is determined by three groups of variables: task motivation, domain-relevant skills, and creativity-relevant processes. No single variable in itself, but rather the complex combination of variables with all of their interactions, would determine an individual's level of creativity (Gardner, 1988; Sternberg, 1999). Not only was an individual's creativity the result of the inputs and interactions of a number of variables, but as Cropley (1999b, p. 513) asserted,

> Knowledge, special skills, techniques, and similar factors play a role in all fields of creativity. The relative importance of particular factors is greater in some domains than in others - knowledge is perhaps more important in science, and technique in music, to take two examples. The specific contents of the elements also vary according to the particular field or activity in question: the specific knowledge required in designing and building bridges may not be very relevant for creative research in, let us say, botany, but both require a knowledge base.

Where Cropley asserted that the relative importance of the contributions of the various variables would be different, depending on the particular domain, Weisberg (1986, p. 144) went farther, reasoning, "The same personality characteristics which supposedly are necessary for creative achievement in one situation may actually interfere with creative achievement in

another." The next sections explore Amabile's (1983, 1996) components of creativity variables, starting with task motivation.

Task Motivation

Task motivation includes all of the motivational variables, both intrinsic and extrinsic, that ultimately shape an individual's desire and approach to the task at hand (Amabile, 1983, 1996; Eysenck, 2004; Hennessey, 2000; Sternberg, 1999). Intrinsic motivation, defined as the motivation arising from "the individual's positive reaction to the qualities of the task itself" (Amabile, 1996, p. 115), was conducive to creativity (Amabile, 1983, 1996; , Davis, 1992; Hennessey & Amabile, 1988; Piirto, 2004). Thus, individuals who found a task interesting, challenging, and enjoyable tended to be more creative than those who found the task onerous or boring (Amabile, 1983; Dacey, 1989; Hennessey, 2000; Sternberg, 1999). In fact, Rossman (1931, as cited in Mackinnon, 1978, p. 87) found when he surveyed over 700 patent-holding inventors, that the single response given most often to the question of "What motives or incentives cause you to invent?" was the "love of inventing." Guilford (1950) summed up the role of motivation in creative achievement when he said, "Whether or not the individual who has the requisite abilities will actually produce results of a creative nature will depend on his motivational and temperamental traits" (p. 444).

In contrast to intrinsic motivation, extrinsic motivation is motivation that arises from external sources, such as expected evaluations and contracted rewards (Amabile, 1996). The relationship between extrinsic motivation and creativity is much more complicated and there is no consensus regarding how an individual's level of extrinsic motivation affects creativity. Some claimed that extrinsic motivation is detrimental to creativity (Amabile, 1983, 1996; Hennessey,

2000; Hennessey & Amabile, 1988), while others claimed that extrinsic motivation was almost always conducive to creativity (Eisenberger & Cameron, 1996).

Domain-Relevant Skills

The second component in Amabile's framework, Domain-relevant skills, consists of an individual's level of factual knowledge and technical skills (Amabile, 1983). According to Amabile (1996, p. 83), domain-relevant skills "can be considered as the basis for performance in any given domain." In the domain of military planning, domain-relevant skills include such things as the technical knowledge of the strength, orientation, and capabilities of both friendly and enemy units, knowledge of the terrain, knowledge of the appropriate doctrine, and processes for conducting planning (Department of the Army, 2005). Domain-relevant skills play key roles in the preparation and response validation steps of the creative problem-solving process as the individual first amasses the required information about the problem and subsequently tests and evaluates any potential solutions developed (responses) for appropriateness or correctness (Amabile, 1996; Simon, 2001).

The need for extensive domain-relevant knowledge is reflected in the widely-accepted 10-year rule, which states that most significant creative achievements occur after the individual has immersed himself in his chosen domain for over 10 years (Gardner, 1993; Simonton, 1994). Mayer (2006, p. 154) stated, "Creative problem solving favors the prepared mind," adding, "A prepared mind is one that possesses domain-specific facts, concepts, strategies, procedures, and beliefs." Without a supply of knowledge pertinent to the domain of the problem at hand, there can be no new and original way of arranging ideas and concepts (Guilford, 1950). From a simplistic mathematical perspective, the more pieces of knowledge that an individual has in mind

about a given domain, the greater the number of potential combinations of ideas the individual can generate (Rietzschel, Nijstad, & Stroebe, 2007).

The field of creativity researchers appeared to agree that a lack of domain-relevant knowledge can impede the development of novel and effective ideas. Rabe (2006) added an interesting new dimension to the relationship between domain-relevant knowledge and creativity. In addition to affecting the ability of the would-be problem-solver to generate a novel and appropriate solution, she asserted that a shortfall of domain-relevant knowledge would prevent the individual from even the task of correctly identifying the problem. Additionally, a lack of domain-relevant knowledge might prevent the individual from effectively communicating the creative solution to the field in a way to ensure its acceptance and implementation (Sternberg, 1999).

While it is clear that creative achievement is improbable if the individual in question possesses limited knowledge in the given domain, the relationship between knowledge and creativity is not necessarily a linear one (Wynder, 2007). The specific domain also is important due to the probability that differing domains require not only different sets of prerequisite knowledge, but also different levels (Cropley, 1999b). Cropley (1999b, p. 514) also theorized that, depending on the domain, the relationship between domain knowledge and level of creativity could be one of an inverted "U shape," and that although knowledge in the domain is clearly necessary and advantageous to a degree, a "Very high level of familiarity with a field and existing solution strategies can preorganize thinking so effectively that it leads only to singularity (tried and trusted, correct approaches)."

Creativity-Relevant Skills

The final component of Amabile's (1996, p. 87) framework is comprised of creativity-relevant skills, the "something extra of creative performance." Amabile (1996, p. 87) said, "An individual's use of creativity-relevant skills determines the extent to which his product or response will surpass previous products or responses in the domain." Given an appropriate level of motivation, if the individual possesses the requisite domain-relevant knowledge and skills, performance is likely to be adequate. It is an individual's creativity-relevant skills that determine if the individual sees the problem in a new way, brings together ideas and concepts that have never before been combined, and produces truly creative work (Amabile, 1996). Knowledge and intelligence alone do not make an individual creative (Getzels & Jackson, 1962; Sternberg & O'Hara, 1999). A large accumulation of past knowledge in a given domain does not guarantee that an individual is a creative producer of new knowledge beyond that which is already known (Taylor, 1988). Creativity-relevant skills therefore determine just how creative an individual could be (Amabile, 1996); one of the most critical aspects of an individual's creativity-relevant skills is the individual's cognitive style. Four characteristics of an individual's cognitive style that influence the level of creative performance are the ability and inclination to (a) break perceptual and cognitive set, (b) understand complexities, (c) suspend judgment and keep response options open as long as possible, and (d) use wide and flexible categories (Amabile, 1996).

Perceptual and cognitive set. Thompson (1966, p. 60) stated, "Perception refers to the act of perceiving or awareness, whereas set affects what will be perceived and how it will be perceived." Set can be thought of as a readiness to think or act in a given way, and an individual's set is determined by prior experiences, values, needs, attitude, and emotions

(Thompson, 1966). Perceptual set leads individuals to see what they expect to see or hear what they expect to hear. Through experience and education, individuals tend to develop habitual ways of seeing and comprehending that limit their flexibility (Davis, 1999).

The formation of a perceptual set is a natural function enabled by the plasticity of the brain that serves a valuable purpose by enabling individuals to function in their everyday lives without having to scrutinize every stimulus that they encounter (Ashcroft, 2006). It can be reinforced by a number of variables, including how recently the individual has perceived a given stimulus, how many times in the past the individual has perceived a given stimulus, and how significant emotionally the perception of the stimulus was to the individual in the past. The more recent, the more frequent, and the more emotionally significant the perception of a given stimulus is to an individual, the greater his predisposition, or set, will be to perceive it again (Reisberg, 2006). A good example of perceptual set would be the readiness to hear the word "pepper" after hearing the word "salt" (Thompson, 1966).

Cognitive set is the readiness to engage in a particular thought process (Thompson, 1966). The act of cognition is not simply a passive acceptance of everything that impinges upon the senses or is already stored in the mind, but instead consists of a complex process of

1. selecting input from the masses of possible available stimuli,
2. relating input to the existing knowledge networks,
3. combining elements of the new information with the existing knowledge,
4. evaluating the resultant emerging new concepts and ideas,
5. selectively retaining new concepts as useful and appropriate, and
6. communicating the results to others (Cropley, 1999a).

Perceptual set influences step 1 above and cognitive set influences steps 2 and 3 above. One who has difficulty breaking perceptual or cognitive set is less efficient at the steps above. A highly creative individual is inclined to and able to break set and to demonstrate more discrimination of stimuli and nuanced judgment (Cropley, 1999b). Sternberg (1988, p. 325) summed the situation up with the statement that creative people "harbor a set-breaking set."

Complexity. Complexity is a relative term that generally refers to the number of parts a problem or situation has, the degree to which these parts are interrelated, and the degree to which these interrelations are transparent to the problem solver (Loasby, 1976). Amabile (1996) stated that understanding complexity is important to creative achievement, implying a need for in-depth understanding of intricate problems for an individual to be creative. Others referred to the importance for an individual to be attracted to complexity in order to be creative (Barron & Harrington, 1981; Cropley, 2000; Dacey, 1989; Davis, 1999; Gough, 1979). In fact, Barron and Harrington referred to attraction to complexity as a key attribute of creative people.

The difference between understanding and being attracted to complexity is not one of mere semantics. The former speaks to ability, the latter to interest. Mackworth (1965, p. 54) stated, "Creative people have an exceptionally strong need to find order where none appears on the surface." Research findings by Kuusinen (1970) indicated that the relationship between preference for complexity and creativity is actually curvilinear. She found creativity, as measured by fluency and originality of ideas, increased with preference for complexity up to a certain threshold, above which both originality and fluency of ideas dropped off sharply (Kuusinen, 1970). Although there remains no established consensus regarding a causal relationship, it is clear that individuals who are intolerant of or avoid complexity tend to be uncreative (MacKinnon, 1962).

Judgment and response options. "There is always an easy solution to every human problem: neat, plausible, and wrong" (Henry Louis Mencken, 1917). Artists who approach their canvas without a definite plan were found to be more creative than their counterparts (Amabile, 1996). It appears important for creative achievement in some domains that the individual prefers avoiding premature convergence (Basadur et al., 2000). Creativity requires that the individual separates the idea development from the idea evaluation for as long as possible, ensuring the maximum amount of ideas generated (Basadur et al., 2000). The opposite of this, the need for closure, is characterized by an individual's urgent need for an answer, any answer (Kruglanski, Pierro, Mannetti, & De Grada, 2006). An individual with a high need for closure cannot allow the time required for the spreading memory search, which is theorized to be the cognitive process underlying novel associations (Gabora, 2002). The individual high in need for closure cannot take a break from an unsolved problem and permit incubation to take place (Wallas, 1970). As Rogers (1970, p. 143) stated, "[to be creative requires the] ability to receive much conflicting information without forcing closure upon the situation."

Wide and flexible categories. Amabile (1996, p. 88) stated, "Individuals who categorize information in "wide" as opposed to "narrow" categories, who see relationships between apparently diverse bits of information, may be more likely to produce creative works and responses." The formation of useful categories and concepts is among the most basic of all inductive tasks (Holyoak & Nisbett, 1988). Due to the excessive amount of stimuli individuals are exposed to every day in the world, they seek to avoid stress and cognitive overload by selectively paying attention to some stimuli while filtering out and ignoring others (Cropley, 1970.) Individuals differ on the degree to which they accept or filter stimuli. Research has shown that the more individuals filter out stimuli, the less open they are to experience, the less

interconnected their memories and developed networks are, and ultimately for purposes of the present study, the less creative they are (Cropley, 1970, 1999a; Holyoak & Nisbett, 1988; Reisberg, 2006; Tversky & Hemenway, 1984). In addition to the volume of stimuli accepted as opposed to being filtered out, individuals differ in how they categorize new information.

Describing the categorization process, Cropley (1970) stated that when exposed to a new stimulus, individuals seek to understand it and predict its qualities by comparing it to their existing knowledge base. In this way, individual events are tied together in such a way that a narrative is formed and meaning is given to events or objects encountered. Because an individual rarely has the time, availability, or inclination to survey all possible information about a new object or person encountered, the person "fills in" the missing information (Reisberg, 2006). To do so, the individual compares what can be observed of the object with personal existing knowledge, and gives it meaning by connecting the new object to known objects by similarity (Cropley, 1970). "Mental representations of categories make it possible to deal with the ubiquitous variability of experience by enabling us to treat instances of the same category in the same way for certain purposes" (Holyoak & Nisbett, 1988, p. 66).

Individuals therefore can assign objects to categories because they tend to appear together, either spatially or temporally, or they have similar form or function, or for any number of reasons (Holyoak & Nisbett, 1988). Individuals can form categories from the bottom up or the top down. "Bottom-up induction involves the detection of multiple correlated properties that make the instances of the category stand out as a natural class, distinct from other categories (Holyoak & Nisbett, 1988, p. 66). These are sometimes called natural categories (Reisberg, 2006). The other type of categorization is top-down categorization, which occurs when the

individual forms categories based upon abstractions such as motion or proportion (Holyoak & Nisbett, 1988).

Perception is entirely subjective, and individuals make their own categories and form their own mental representations of those categories based upon their own experiences, values, or cognitive style (Ashcroft, 2006; Bruner, 1973; Cropley, 1970). "Clearly, the more a person treats data which look to have nothing to do with each other as though they are related, the more likely he is to make data combinations which are unusual (i.e., to think creatively)" (Cropley, 1970, p. 120). Massaro and Ferguson (1993, p. 25) stated, "[People] differ in terms of broadness and narrowness of judgments of category width–to what extent they will accept exemplars as good instances of a category." The more the individual groups dissimilar objects, events, and concepts together, the wider his category width is considered to be. Conversely, the more an individual demands objects be similar to be placed in the same category, the more narrow his category width (Cropley, 1970; Massaro & Ferguson, 1993). The act of categorization, however, is not a deliberate act; individuals are usually unaware of their categorization or their relative width of category (Bruner, 1973; Massaro & Ferguson, 1993). Individuals who utilize wide categories tend to be more creative than individuals who utilize narrower categories (Cropley, 1970; Martindale, 2007; Massaro & Ferguson, 1993). The next section provides a review of the literature surrounding the concept of tolerance of ambiguity.

Tolerance of Ambiguity

Ambiguity and Perception

The concept of ambiguity relates to an individual's ability to make meaning of the stimuli the person encounters (Budner, 1962). Werman (1979, p. 108) stated, "Ambiguity refers

primarily to meaning and is defined in two different ways: the first relates to imprecision, uncertainty, or vagueness of meaning; the second concerns the presence of two or more meanings." Emphasizing the subjectivity of perception, Zimbardo, Johnson, and Weber (2006, p. 205) suggested, "Perception brings meaning to sensation, so perception produces an interpretation of the world, not a perfect representation of it." In the cognitive sense, something is ambiguous if it can have more than one meaning (Ashcraft, 2006), such as the word "bench" or the newspaper headline, "Bulls and Bears Face Similar Challenges" (Sherwood, 2002). Visual stimuli can be just as ambiguous, such as the image in Figure 3. Depending on how an individual looks at it, the image typically appears to be either a young woman with her head facing away or an old hag (Schmidt, 2005; Zimbardo et al., 2006).

Figure 3. Ambiguous figure: young lady or old hag?

Note. From *Illusions and Ambiguous Figures* by C. F. Schmidt, 2005, Rutgers University, New Brunswick, NJ. Adapted with permission of the author.

Ambiguity is a completely subjective concept, centered on the individual perceiver (Budner, 1962). An object or situation cannot in and of itself be ambiguous (Reisberg, 2006). The degree to which something is ambiguous has a lot to do with how the particular individual perceives stimuli and processes information (Reisberg, 2006). Obviously, the word "bench" is ambiguous to individuals only if they know more than one meaning of the word (Reisberg, 2006).

When faced with an ambiguous stimulus, the individual typically seeks to determine the meaning that makes the most sense, given the context (Reisberg, 2006). In some cases, ambiguity is caused by a lack of information, such as hearing only part of a sentence, seeing only a small portion of an object, or reading a written communication, absent the often critical accompanying facial expressions and voice inflections. In such cases, an appropriate strategy for reducing the level of ambiguity would be to seek additional information.

Perceptual and cognitive set play a significant role in how individuals resolve ambiguity and make meaning of the stimuli that they encounter (Holyoak & Nisbett, 1988; Thompson, 1966). When faced with the text depicted in Figure 4, most individuals read it as "THE BAT," interpreting the middle symbol as an H in the first word and an A in the second. People read the text in this manner because they are familiar with the words, "THE" and, "BAT," and are not familiar with any words spelled, "TAE" or, "BHT". In this case, the reader interprets the middle symbol of the two words in two different ways even though the symbol is identical in each. The reader does this easily and without thought because "THE BAT" is the only interpretation that makes sense, given the context. This example reinforces the earlier discussion on perceptual set. Reading this text as "THE BAT" would of course be automatic only to someone who speaks

English. What happens when there are either multiple or no interpretations that seemingly make sense?

Figure 4. The impact of context and experience upon the resolution of ambiguity.

The impact of context and experience upon the resolution of ambiguity. Does the figure above read "TAE BAT," "THE BHT," or "THE BAT?" Even though the middle symbol is the same for both groupings, most readers seek to make familiar words of the groupings and therefore read it as the latter because that is the only solution that, to them, makes sense.

Just such a stimulus was found in 1832 when Swiss mineralogist Louis Albert Necker reported his observation that line drawings of crystals appeared to reverse spontaneously (Flinn, 2000). Based upon these crystals, the Necker cube (Figure 5) is a line drawing of a cube that appears to alternate between two different spatial orientations when viewed continuously. Frenkel-Brunswik (1948) asserted that when faced with such ambiguous stimuli, individuals who are tolerant of ambiguity would see fluctuation and repeated reversal of position or meaning. Conversely, individuals who are intolerant of ambiguity would select an interpretation early, and rigidly resist any modification or change (Frenkel-Brunswik, 1948). In one test, Kenny and Ginsberg (1958) used the Necker cube as a tool to measure individual's levels of tolerance of ambiguity by counting the number of times that they reported a shift in the apparent spatial orientation of the cube within a 60-second time span. Cipywynk (1959) reported that although individuals did differ on the rate of reversal of such ambiguous figures, variables such as illumination, contrast, and motivation were also important to an individual's score.

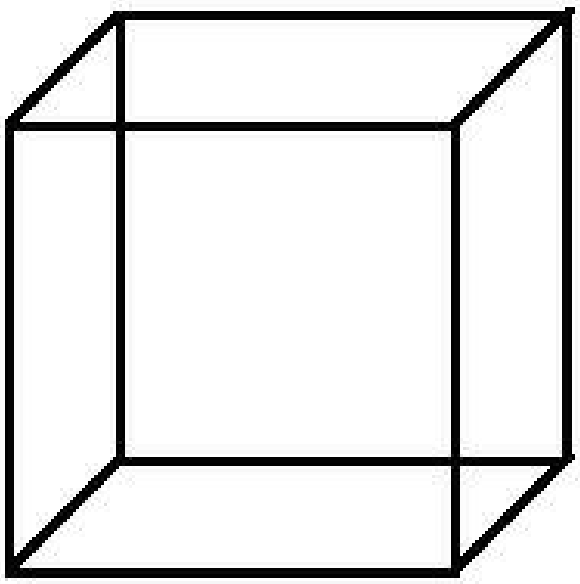

Figure 5. The Necker Cube**.**
The Necker Cube appears to change orientation when stared at. Kenny and Ginsberg (1958) used it to assess AT levels by measuring the amount of times an individual reports an orientation change when staring at the cube for 60 seconds.

Note. From "The Specificity of Intolerance of Ambiguity Measures" by D. T. Kenny & R. Ginsberg, 1958, *Journal of Abnormal Social Psychology, 56*, pp. 300-304. Adapted with permission of the author.

Tolerance of Ambiguity as a Personality Trait

The concept of tolerance of ambiguity (AT) refers to how an individual or group "perceives and processes information about ambiguous situations or stimuli when confronted by an array of unfamiliar, complex, or incongruent clues" (Furnham & Ribchester, 1995, p. 179). Budner (1962, p. 29) defined intolerance of ambiguity as "the tendency to perceive (i.e., interpret) ambiguous situations as a source of threat." He defined (p. 30) an ambiguous situation as "one which cannot be adequately be structured or categorized by the individual because of the lack of sufficient cues." He added there are typically three types of ambiguous situations:

1. Completely new situations in which the individual has had no experience and therefore finds no familiar cues,

2. Overly complex situations in which there are too many cues for the individual to process,
3. Contradictory situations in which the available cues lead to different and perhaps mutually exclusive structures.

Budner (1962, p. 30) summarized the three conditions of ambiguous situations as "novelty, complexity, and insolubility." Much like the discussion earlier regarding the distinction between understanding and preferring complexity, the Budner definition (1962) speaks to the way the individual feels about ambiguous situations, not his capacity for perceiving or understanding. Kenny and Ginsberg (1958) stated that the behavior of an individual who is intolerant of ambiguity can be characterized by

1. Resistance to reversal of apparent fluctuating stimuli,
2. The early selection and rigid maintenance of one solution in a perceptually ambiguous situation,
3. Inability to allow for the possibility of good and bad traits in the same person,
4. Acceptance of attitude statements representing a rigid white-black view of life,
5. Seeking for certainty,
6. A rigid dichotomizing into fixed categories,
7. Premature closure,
8. Remaining close to familiar characteristics of stimuli.

Frenkel-Brunswik (1948, 1949) developed the concept of tolerance of ambiguity when conducting research into ethnic stereotyping. She found (1948) that individuals who tended to be prejudiced against people from different ethnic groups also tended to be rigid in their cognitive processes and lean toward rigid categorization. She described (1949) the phenomenon as one in

which “Assumptions once made, no matter how faulty and out of keeping with reality because of a neglect of relevant aspects, are repeated over and over again and not corrected in the face of new evidence” (p. 119).

Tolerance of ambiguity then can be thought of as a personality variable that “generalizes to an individual’s entire emotional and cognitive functioning, characterizing his cognitive style, his belief and attitude systems, his interpersonal and social functioning, and his problem solving behavior” (Bochner, 1965, p. 393). Fromm (1959) described what he calls the attitude of creativity as one in which the individual can accept conflict and tension rather than avoiding them. Kirton (1981) looked at the situation from the perspective of someone who is tolerant, as opposed to intolerant of ambiguity. He (1981) determined that an individual highly tolerant of ambiguity:

1. Preferred thinking tangentially, approaching tasks and problems from unsuspecting angles,
2. Tended to be undisciplined and unpredictable,
3. Tended to discover problems that others had not seen,
4. Tended to query problems’ underlying assumptions, taking nothing for granted,
5. Did things differently from the mainstream, challenging conventions and accepted norms.

Some researchers have sought to determine the stability of individuals’ levels of tolerance of ambiguity. Edelstein (2007) reported increasing individuals’ tolerance of ambiguity levels through training sessions. Glover, Romero, Romero, and Peterson (1978) found that individuals’ levels of tolerance of ambiguity, as measured by Budner’s (1962) Intolerance of Ambiguity Scale, could be increased by having them participate in a cross-cultural simulation game. Ghosh

(1994), however, concluded from his research that individuals' levels of tolerance of ambiguity, also measured by Budner's (1962) Intolerance of Ambiguity Scale, could only be measured and not manipulated.

Following and building upon Frenkel-Brunswik's identification of tolerance of ambiguity as an individual personality trait, many researchers have theorized a correlation between individuals' level of tolerance to ambiguity and their level of creativity (Amabile, 1983, 1996; Barron & Harrington, 1981; Cropley, 1999a; MacKinnon, 1978, 1998; Piirto, 2004;). This next section explores the literature to complete understanding fn the theoretical and empirical basis for the relationship.

The Relationship between Tolerance of Ambiguity and Creativity

In theory, there exists a significant relationship between tolerance of ambiguity and creativity (Sternberg, 1999). An individual must have the desire, willingness, and ability to cope with unstructured and open-ended situations in order to think creatively effectively (Tegano, 1990). Intrinsic motivation has been shown to be a strong contributor to creative achievement (Amabile, 1983, 1996; Hennesey, 2000; Hennessey & Amabile, 1988). Tolerance of ambiguity is therefore theoretically an important contributor to creativity because it "empowers the intrinsically motivated exploration of novel, unusual, or complex stimuli" (Zenasni, et al., 2008, p. 6). Barron and Harrington (1981) stated that creative achievers tend to be attracted towards complexity. Dacey (1989, p. 6) suggested, "The first characteristic of the creative person is tolerance of incongruity, which could be called tolerance of ambiguity. Its opposite could be called fear of the unknown or unfamiliar." Eysenck (1993, p. 155) agreed, concurring that highly creative individuals, "can live with doubt and uncertainty, even enjoying risks and seeking out instabilities in the world."

Additionally, the cognitive processes of thinking creatively and producing novel ideas or original combinations of previously unconnected existing ideas has been described as finding remote associations between objects or ideas (Mednick, 1962). The more remote the association found, the more creative the idea, and thus creativity has been described as a trait of associational fluency (Tagano, 1990). In theory then, an individual who is intolerant of ambiguity will categorize stimuli more quickly (Frenkel-Brunswik, 1949), seek closure more quickly (Frenkel-Brunswik, 1949), and will therefore be much less likely to find the remote associations that lie at the heart of creative thought (Mednick, 1962).

Researchers have theorized that tolerance of ambiguity is more than just another factor influencing creativity. Tardiff and Sternberg (1988) identified tolerance of ambiguity as one of the three most significant characteristics of creative people, along with a willingness to accept risk and an inclination towards nonconformity. Cropley (1999a) went so far as to assert that possessing a high level of tolerance of ambiguity is a prerequisite to creative thought, and at least two theorists (Sternberg, 1999; Vernon, 1970) have referred to tolerance of ambiguity as the *sine qua non* of creative accomplishment.

It is not just researchers and theorists such as Sternberg and Cropley who have asserted the important role that tolerance of ambiguity plays in enabling creative achievement. In his collection of letters and correspondence from such men as Poincaré, Mozart, Einstein, and Yeats, Ghiselin (1952) has provided their first-hand accounts of what went on in their minds as they produced creative works in such domains as mathematics, physics, art, and poetry. Ghiselin (1952) never used the term, 'tolerance of ambiguity,' but in describing the act of creative thinking based upon the themes uncovered in the words of the great creators themselves, he said,

> Even to the creator himself, the earliest effort may seem to be a commerce with disorder. For the creative, which is an extension of life, is not an elaboration of the

> established, but a movement beyond the established, or at the least a reorganization of it and often of elements not included in it….This is the reason why, in order to invent, one must yield to the indeterminate within him, or, more precisely, to certain ill defined impulses which seem to be of the very texture of the ungoverned fullness which John Livingston Lowes calls "the surging chaos of the unexpressed." (1952, p. 14)

Kenny and Ginsberg's (1958) characteristics of individuals highly intolerant of ambiguity included the tendency for early selection and rigid adherence to a single belief or solution to problem. In contrast, Amabile's (1996) characteristics of cognitive style required for creativity included the ability to suspend judgment and to keep response options open as long as possible, as well as the ability and inclination to break cognitive set when appropriate. For ease of comparison and contrast, Table 1 depicts Kenny and Ginsberg's (1958) characteristics of intolerance of ambiguity alongside Amabile's (1996) characteristics of cognitive style required for creativity. Such comparison shows the theoretical basis for the association between tolerance of ambiguity and creativity. Amabile (1996) stated that for individuals to be creative, they must be inclined to delay judgment and they must use wide and flexible categories. Kenny and Ginsberg stated that an individual who is intolerant of ambiguity seeks premature closure and uses narrow and rigid categories.

Similar to Kenny and Ginsberg's (1958) results, Wallach and Kogan (1970) found that individuals who had high levels of intelligence and low levels of creativity tended to be "intolerant of unlikely, unconventional types of hypothesizing about the world." (p. 251). Wallach and Kogan (1970) also found that these highly intelligent but uncreative individuals tended to categorize objects much more quickly than creative individuals, and to categorize them by descriptive property rather than by theme or abstraction.

Table 1.
Comparison of Kenny and Ginsberg's (1958) Characteristics of Intolerance of Ambiguity with Amabile's (1996) Characteristics of Cognitive Style Required for Creativity

Characteristics of Intolerance of Ambiguity (Kenny & Ginsberg, 1958)	Characteristics of Cognitive Style Required for Creativity (Amabile, 1996)
Tendency for early selection and rigid maintenance of one solution in a perceptually ambiguous situation	Ability and inclination to break perceptual and cognitive set
Tendency for acceptance of attitude statements representing a rigid view of life	Ability to understand and preference for complexities
Tendency for premature closure	Ability and inclination to suspend judgment and keep response options open as long as possible
Tendency to assign stimuli to rigid dichotomous categories	Tendency to use wide and flexible categories

However, the empirical results were not unambiguous. Katz (2002) conducted research into the relationships between various personality characteristics, including tolerance of ambiguity and creativity in scientists. Katz had a sample of 102 scientists submit descriptions of a scientific work product developed specifically for the study, which were then evaluated for creativity levels using the Creative Product Semantic Scale (CPSS) (Katz, 2002). She assessed the participants' levels of tolerance of ambiguity using Kirton's (1981) Tolerance of Ambiguity Test. Katz found no significant relationship between the scientists' tolerance of ambiguity levels and the levels of creativity of their scientific work products.

Basdur, Runco, and Vega (2000) also found no association between an individual's preference for avoiding premature convergence and fluency or originality of ideas generated. However, these findings may be because there was no attempt to evaluate the merit of the ideas, only their quantity and originality. As discussed in the earlier sections, for an idea to be judged creative, it should be both novel and appropriate (Simon, 2001). Murphy (2000) found no significant relationship between tolerance of ambiguity and creativity levels of nursing students. Additionally, Pestonjee, Pathak, Dhar, and Chauhan (1999) found no significant correlation between tolerance of ambiguity and creativity in individuals serving in managerial roles in both the public and private sectors.

Plucker and Renzulli (1999) on the other hand, found that highly creative individuals had a greater preference for complex figures on the Barron-Welsh Art Scale than did their noncreative counterparts. Vartanian (2009) found that highly creative individuals had quicker response times at unambiguous tasks and longer response times at ambiguous tasks than did individuals with lower levels of creativity, and interpreted this to indicate that as the ambiguity of the task goes up, highly creative individuals spend more time than do uncreative individuals at building understanding. Golann (1963) determined that individuals higher in tolerance of ambiguity were higher in originality than were individuals more intolerant of ambiguity. Mackinnon (1962, p. 488) stated, "All creative groups that we have studied have shown a clear preference for the complex and asymmetrical, and in general, the more creative a person is, the stronger is this preference."

Tegano (1990) found tolerance of ambiguity related to scores on the Myers Briggs Creativity Index. Zenasni et al. (2008) report finding a positive correlation between tolerance of ambiguity and creativity of children and their parents in France. Stoycheva (2008) found a

positive association between tolerance of ambiguity and creative motivation among Bulgarian students.

The literature has established that the prevailing theory supports a relationship between tolerance of ambiguity and creativity (Amabile, 1983, 1996; Rogers, 1959; Sternberg, 1988, 1999; Taylor & Barron, 1963; Urban, 2003; Zenasni et al., 2008). However, as with any relationship between variables, going from the theoretical expectation to the empirical requires an instrument of measurement. Accordingly, the next section reviews the literature surrounding the measurement of tolerance of ambiguity and discusses the instrument selected for use in this research.

Assessing Tolerance of Ambiguity

"The proliferation of [instruments] purporting to measure the same psychological construct poses various problems for researchers." (Furnham & Ribchester, 1995, p. 407)

Since Frenkel-Brunswik (1948) first published her work identifying tolerance of ambiguity as a personality variable, many different instruments have been developed to assess it. The first identified instrument to measure tolerance of ambiguity was Frenkel-Brunswik's Dog-Cat Test in which the subjects viewed a picture of a dog and then subsequently viewed sequences of pictures in which the image of the dog gradually became a cat. The individual's level of tolerance of ambiguity corresponded with how quickly they modified their interpretation of a dog (Grenier, Barrette, & Ladouceur, 2005). Another test involving the interpretation of visual images involved the use of ambiguous figures such as the Necker Cube (Kenny & Ginsberg, 1958). Subjects would stare at the figure for a specified duration and record the number of times the perception reversed. The individual's tolerance of ambiguity score corresponded to the

number of perceptual reversals they reported during the specified time (Kenny & Ginsberg, 1958).

Another test utilizing the perception of visual images was one in which subjects were presented a series of 50 Rorschach ink blots, and were asked a question with each one. The questions were of the nature, "Could this be a _____?" with the blank being a different object each time (Davids, 1955). To this, the subjects would respond either in the affirmative or in the negative. An individual's tolerance of ambiguity score corresponded to the number of affirmative answers.

Another type of instrument designed to measure an individual's tolerance of ambiguity levels involved making estimations of object properties. In one such test, subjects were presented 16 cans of varying weights, allowed to pick each of them up individually, and required to estimate their weight with respect to a given standard. They were to identify each can as either heavier, lighter, or "might be heavier or lighter, I can't decide which" (Hamilton, 1957, p. 201). The tolerance of ambiguity score corresponded to the number of cans identified as falling into the third category (Hamilton, 1957).

Budner (1962) also developed a questionnaire that assessed individuals' levels of tolerance of ambiguity. It consisted of 24 items in the form of statements such as, "An expert who doesn't come up with a definite answer probably doesn't know too much" (Budner, 1962, p. 34). For each item, subjects indicated the degree to which they agreed or disagreed on a 6-point Likert-type scale. Since that time, Rydell and Rosen (1966), MacDonald (1970), and Norton (1975) each developed a different version of a pencil and paper test similar to that developed by Budner.

Benjamin, Riggio, and Mayes (1996, p. 131) conducted a study of Budner's (1962) instrument and concluded that, due to its low level of internal reliability, it was a "poor measure of tolerance for ambiguity." Furnham (1994) also conducted a study of instruments designed to measure tolerance of ambiguity. In a meta-analysis of four tests, Walk's, Budner's (1962), Rydell's scale (Rydell & Rosen, 1966), and Norton's (1975), Furnham found the Norton (1975) MAT-50 to have the highest internal reliability ($\alpha = .89$ of any of the instruments they examined.

Norton's Measurement of Ambiguity Tolerance (MAT-50)

Norton (1975, p. 608) defined the construct of intolerance of ambiguity as "a tendency to perceive or interpret information marked by vague, incomplete, fragmented, multiple, probable, unstructured, uncertain, inconsistent, contrary, contradictory, or unclear meanings as actual or potential sources of psychological discomfort or threat" and he based his instrument to measure individuals' levels of ambiguity tolerance (MAT-50) on eight themes:

1. Multiple meanings: "The stimulus was considered ambiguous by the researcher when it entailed at least two meanings, whether the person was aware or unaware of the multiple meanings, or clear or unclear about them" (Norton, 1975, p. 608).
2. Vagueness, incompleteness, fragmented: "If parts of the whole were missing, the stimulus was designated as ambiguous. Examples included incomplete line tracings or fragmented figures" (Norton, 1975, p. 608).
3. As a probability: "A stimulus was treated as though it were ambiguous if it could be analyzed as a function of a probability" (Norton, 1975, p. 608).
4. Unstructured: "A stimulus which has no apparent organization or only partial organization was considered ambiguous" (Norton, 1975, p. 608).

5. Lack of information: “A situation in which there was no information or very little information was treated as an ambiguous situation” (Norton, 1975, p. 608).
6. Uncertainty: “Ambiguous was equated to the state of mine it created: namely uncertainty. In this sense, ambiguity was considered a consequent of a situation, event, interaction, etc” (Norton, 1975, p. 608).
7. Inconsistencies, contradictions, contraries: “Any stimulus or stimulus set which entailed discrepant information was considered ambiguous. For example, if a set of information suggested that something could be X and not-X at the same time, that set of information would be labeled ambiguous” (Norton, 1975, p. 608).
8. Unclear: “Sometimes ambiguous was used synonymously with the word unclear” (Norton, 1975, p. 608).

The MAT-50 has been found to have high internal validity (r =.88), and a high-retest validity (r =.86) over a 10- to 12-week period. A content analysis using 20 graduate students indicated adequate content validity (Norton, 1975). Its construct validity was also found good through four independent empirical studies (Norton, 1975).

Norton’s (1975) MAT-50 has been used in a number of research works published in peer-reviewed journals. Comadena (1984) used Norton’s (1975) MAT-50 as the instrument to measure tolerance of ambiguity in his research into factors surrounding individuals’ productivity in brainstorming groups. Viswanathan (1997) used a shortened version of the MAT-50 as the instrument to measure tolerance of ambiguity in his research to develop an instrument for assessing individuals’ levels of need for precision. Zenasni et al. (2008) also used a shortened version of the MAT-50 as an instrument to assess tolerance of ambiguity in their research into the relationship between tolerance of ambiguity and creativity in children and their parents.

Stoycheva (2001) and Stoycheva and Lubart (2008) used a Bulgarian adaptation of the MAT-50 in two studies of the relationship between tolerance of ambiguity and creative motivation, one of which was presented at the 29th Symposium of the International Congress of Psychology, held in Berlin during August, 2008.

Due to its determined internal reliability and validity, along with its acceptance by the field, the researcher used the MAT-50 as the instrument for measuring the officers' AT levels in this study. Additional specifics of the MAT-50 are discussed in the methodology chapter. The next section of this chapter reviews the literature regarding a number of other concepts that have other names, but are very closely related in meaning to tolerance of ambiguity.

Concepts Related to Tolerance of Ambiguity

Krohne (1989) and more recently Grenier et al. (2005, p. 593) published research regarding a concept called "intolerance of uncertainty." The concepts of intolerance of ambiguity and intolerance of uncertainty appear to be similar, and indeed, each usually appears in the definition of the other (Grenier et al., 2005). Perhaps the only subtle distinction between the two is in the dimension of time, where tolerance of ambiguity is normally thought of as sensation regarding the assessment of a present condition and tolerance of uncertainty is normally thought of as a sensation regarding the perception of a future condition.

Chabassol and Thomas (1975, p. 510) published a study of a concept they called "need for structure" (NFS). The researchers defined structure as task-relevant guidance, advice, information, clarity, or direction. As would be expected, NFS was found to be strongly and negatively correlated with tolerance of ambiguity (Chabassol & Thomas, 1975).

The concept of cognitive rigidity has been the subject of research published by some of the most highly respected researchers in psychology over the past hundred years (Schultz &

Searleman, 2002). Rokeach (1960) defined the concept as a resistance to change beliefs, attitudes, or personal habits. Schaie (1955, p. 604) defined the concept as "inflexibility of thought and manner." Through the years, additional definitions have been posed, but the overall understanding of the concept has remained relatively consistent–an individual is cognitively rigid if he or she perseverates in holding a belief or opinion, or in the use of method or strategy, especially in the presence of information highlighting the appropriateness of change (Schultz & Searleman, 2002).

Much like the concept of tolerance of ambiguity, many different tests have been designed to measure cognitive rigidity. One of the more ingenious tests of rigidity was "the jar test" (Schaie, 1955, p. 605), in which subjects had to provide solutions to a sequence of problems using reasoning and basic mathematical skills. The first four problems all could be solved only by using an identical complex formula. The next three could be solved either through the previously learned formula or by using a simple and more direct formula. Problem 8 could not be solved using the complex formula, but could be solved using a simple and direct formula. Like problems 5-7, problems 9 and 10 could once again be solved using either a complex or a simple formula. An individual's rigidity score was determined by how many problems he solved using the simplest available formula, as opposed to staying with the complex formula throughout (Schaie, 1955). Robson, who has studied the effect of organizational environment and culture on cognitive rigidity, added a caution: cognitive rigidity is especially troublesome "for organizations that assess [and operate among] complex real world uncertainties and postulate possible outcomes" (2005, p. 1). Military officers certainly are required to do precisely that.

Kruglanski et al. (1993) published research of a concept they called the "need for cognitive closure." Individuals with a high level of the need for cognitive closure categorize

stimuli quickly, even without attempting to detect relevant cues, and they are "less likely to reexamine [their judgments] in the light of new advocacy" (Kruglanski et al., 1993, p. 861). The need for cognitive closure clearly has much in common with intolerance of ambiguity.

Summary

In summary, the literature stated that an individual who is intolerant of ambiguity feels threatened by situations that he perceived as ambiguous, characterized by uncertainty, complexity, or contradiction (Budner, 1962; Frenkel-Brunswik, 1948, 1949; Norton, 1975). Such an individual tends to seek premature categorization of stimuli into rigid categories, and maintain these categories even in the presence of evidence to the contrary (Frenkel-Brunswik, 1948, 1949; Budner, 1962).

Literature also revealed that for an individual to be creative, he or she needs a cognitive style characterized by an attraction to complexity, a tendency to delay premature closure and categorization, the cognitive flexibility to change perspectives and unite previously unrelated concepts, and the ability and inclination to break perceptual and cognitive set quickly (Amabile, 1996; Sternberg, 1999). Thus, the personality characteristics most-required for creative achievement are the very ones that individuals who are intolerant of ambiguity lack (Amabile, 1996; Budner, 1962; Stoycheva, 2008).

CHAPTER 3 - METHODOLOGY

Introduction

This chapter describes the methodology for this study. Chapters 1 and 2 of this paper contained the introduction to the research and a review of the existing relevant literature regarding the relationship between tolerance of ambiguity and creativity, respectively. This chapter provides the specific details of what this research was designed to determine, as well as how the researcher determined it.

As discussed in the opening chapter, the cognitive demands placed upon military leaders in their current operational environment are immense (Davis, 2008). Military leaders are increasingly faced with complex situations for which they have no readily available textbook solution to apply (Clark, 2008), and they are opposed by clever adversaries who learn and adapt very quickly (Krawchuk, 2008; Pattee, 2008). To succeed in such conditions, military leaders must be able to function, and even excel in conditions characterized by chaos, uncertainty, and ambiguity. They must be capable of developing new and innovative plans and strategies that are both feasible and unanticipated by their adversaries (Bowden, 2008). In short, they must be capable of developing creative solutions to ambiguous and complex problems (Davis, 2008; Hagee, Personal communication, January 8, 2008). It was therefore critical to develop a deeper understanding of the concept of creativity, specifically, the factors that enhance or inhibit the levels of creativity of military commanders and planners.

Purpose Statement

The purpose of this research was to determine if correlations existed between the tolerance of ambiguity (AT) levels of the officers attending the Army School of Advanced Military Studies (SAMS) and the levels of creativity of the military plans they developed. Findings of this research could lead to the development of a deeper understanding of the factors that enhance or inhibit creativity levels in military commanders and planners and facilitate the leadership of the U.S. Army SAMS in efforts to refine curriculum and selection criteria.

Research Questions

The following questions guided this study:

1. Is there a positive correlation between the levels of tolerance of ambiguity of students at the U.S. Army School of Advanced Military Studies at Ft. Leavenworth, KS, and the levels of creativity of the military plans they develop? (Primary research question)
2. How effective is Amabile's Consensual Assessment Technique (CAT) for assessing the level of creativity of military plans? (Secondary research question)

Hypotheses

$H1_A$: There is a positive correlation between the officers' levels of tolerance of ambiguity (AT) and the creativity of the plans they develop.

$H1_0$: There is no correlation between the officers' levels of tolerance of ambiguity (AT) and the creativity of the plans they develop.

$H2_A$: Amabile's Consensual Assessment Technique (CAT) is a reliable instrument for assessing the level of creativity of military plans ($\alpha >$ or $= 0.70$).

$H2_0$: Amabile's Consensual Assessment Technique is a reliable instrument for assessing the level of creativity of military plans ($\alpha < 0.70$).

Design of the Study

This quantitative correlational research used a non-experimental design (Campbell & Stanley, 1963; Neuman, 2007). Correlational research describes the degree to which two or more quantitative variables are related (Fraenkel & Wallen, 2006). In this non-experimental design, no treatments were applied. In this correlational research, the researcher measured the variables without making any attempt at manipulation of them (Campbell & Stanley, 1963; Neuman, 2007; Fraenkel & Wallen, 2006).

Variables

The independent variable for this research was the officers' tolerance of ambiguity scores. The dependent variable was the creativity of the officers' operational military plans.

Instrumentation

Independent Variable: Tolerance of Ambiguity

The participants' level of tolerance of ambiguity was measured by a shortened version of Norton's (1975) Measure of Ambiguity Tolerance (MAT-50). To develop the MAT-50, Norton first performed a content analysis on all of the articles dealing with ambiguity in *Psychological Abstracts* from 1933 to 1970. That content analysis yielded 125 uses of the term "ambiguous,"

which fell into the following eight themes, with the associated percentage of use for each (Norton, 1975, p. 608).

1. Multiple meanings, 28%
2. Vagueness, incompleteness, fragmented, 18%
3. As a probability, 12%
4. Unstructured, 10%
5. Lack of information, 9%
6. Uncertainty, 9%
7. Inconsistencies, contradictions, contraries, 8%
8. Unclear, 5%

Norton (1975) designed the MAT-50 to include items reflecting all eight of these themes. Additionally, each item was developed to incorporate a component of the function of tolerance/intolerance (Norton, 1975). He initiated his work using MacDonald's (1970) 20-item test using a dichotomous scale, which he found during testing to have an internal reliability of only 0.49. Norton revised that test to use a 5-point scale and found that the internal reliability was raised to 0.74, and continued revising and retesting the assessment tool until he arrived at the current MAT-50, some 6 revisions later, with an internal reliability of 0.88 (Norton, 1975). The MAT-50 can be seen in Appendix B.

Content Validity

In order to ensure content validity, Norton built upon the earlier work of Budner (1962), who had asserted that each item must tap "phenomenological denial (repression and denial), phenomenological submission (anxiety and discomfort), operative denial (destructive or reconstructive behavior), or operative submission (avoidance behavior)" (Norton, 1975, p. 610).

Responses on the phenomenological level included perceptions, evaluations, and feelings, whereas responses on the operative level included behavior and action. Within each level, the individual could react to perceived threat either through submission or denial (Norton, 1975). In order to test the content validity of the MAT-50, Norton (1975) compared scores of a sample of communication arts graduate students from the University of Wisconsin to their self-identified assessment of being either very high or very low in tolerance of ambiguity. The results indicated strong content validity, as the self-reported low tolerant individuals had a mean score on the MAT-50 of 55 and the self-identified high tolerant individuals had a mean score of 249 (Norton, 1975).

Criteria-related Validity

To assess the criteria-related validity, Norton (1975) administered the MAT-50 to a sample of individuals, along with the Rigidity of Attitudes Regarding Personal Habits (RAPH) (Meresko, Rubin, Shontz, & Marrow, 1954), the Short Dogmatism Scale (Troldahl & Powell, 1965), Martin and Westie's (1959) Intolerance of Ambiguity scale, Budner's (1962) Intolerance of Ambiguity test, and Rehfisch's (1958) test of rigidity. An analysis of all of the scores reflected significant relationships between the MAT-50 and each of the other instruments, with the sole exception of the Short Dogmatism Scale (Norton, 1975). Norton determined the lack of correlation between the scores on the MAT-50 and those on the Short Dogmatism Scale to be attributable to the distinction between the individuals' lack of permeability of their belief system in the case of the Short Dogmatism Scale and the degree to which they felt threatened by ambiguity. For example, an overly dogmatic individual with an exceptionally closed mind might not perceive a given situation to be ambiguous, precisely because his or her mind has been closed to possible alternative interpretations. The MAT-50

was found to have adequate criteria-related validity due to its correlation (a) with the other tolerance of ambiguity assessment instruments, (b) with self-identification, and (c) with the rigidity assessment tools (Norton, 1975).

Construct Validity

The construct validity was found to be strong due to the results of four empirical studies. In one of the studies, individuals were asked if they would be willing to participate in an experimental study, but provided no details on the study. The MAT-50 was found to discriminate accurately between those who were willing to volunteer for an ambiguous situation, with 24 of the 32 individuals found by the MAT-50 to be highly tolerant of ambiguity, agreeing to participate, as compared to only 6 of the 26 individuals found to be highly intolerant of ambiguity (Norton, 1975). The difference between the two groups was significant at ($X^2 = 15.3$, $df = 1$, $p < .01$).

The MAT-50 is a pencil and paper test with established reliability and validity in measuring an individual's tolerance of ambiguity (Norton, 1975). It is a survey type of self-reporting instrument in which subjects respond to various statements by choosing a Likert item ranging from YES! to NO! (Norton, 1975). As shown in Appendix D, the 61 items are separated into eight sections based upon themes ranging from *Problem-Solving* to *Public Image* (Norton, 1975). Two examples of the items from the *Interpersonal Communication* section of Norton's MAT-50 (1975) are

1. It irks me to have people avoid the answer to my question by asking another question.
2. Before any important job, I must know how long it will take.

The participants responded to these questions by choosing a response on the Likert-type scale below:

YES! yes ? no NO!

A shortened version of the MAT-50 was used in one of the two published research reports investigating the relationship between tolerance of ambiguity and creativity, and was found to have good internal reliability ($\alpha = .78$) and stability (test-retest correlation of $r = .80$) (Zenasni et al., 2008). Additionally, when Furnham and Ribchester (1995) conducted a meta-analysis of four paper and pencil questionnaire instruments to measure tolerance of ambiguity, all were positively correlated, with Norton's MAT-50 having the highest internal reliability.

Dependent Variable: Creativity of the Operational Plans

The level of the creativity of the operational plans was assessed using the consensual assessment technique (CAT) (Amabile, 1996). The CAT is a method for judging the creativity and other qualities of products. Instead of attempting to evaluate the level of creativity of products using a precise and calibrated metric, the CAT relies upon the "independent subjective judgments of individuals familiar with the domain in which the products were made" (Hennessey & Amabile, 1999, p. 347). This method is grounded in an operational definition of creativity:

> A product or response is creative to the extent that appropriate observers independently agree that it is creative. Appropriate observers are those familiar with the domain in which the product was creative or the response articulated. Thus, creative can be regarded as the quality of products or responses judged to be creative by appropriate observers, and it can also be regarded as the process by which something so judged is produced. (Amabile, 1996, p. 33)

This operational definition of creativity emphasizes the fact that the product, which in the case of the present research was the operational plan, was assessed. It was by identifying the highly creative product and determining its creator that the creative person was ultimately identified, for as Weisberg (2006) reminded, "A *creative product*–or an *innovation*–is one that is novel for an individual, and a *creative person* is one who produces such products." (p. 60). Weisberg (2006) added, "Creativity is made up of the factors that enable a person to produce creative products." (p. 60). Such emphasis on the subjectivity of creativity is completely in keeping with the earlier discussions of Czikszentmihalyi's (1988) systems theory of creativity, which posited that for a work to be creative, it must be novel and must be found to have value by a field in a given domain. According to Hennessey and Amabile, "Over 20 years of research have clearly established that product creativity can reliably and validly be assessed based upon the consensus of experts" (1999, p. 348).

Over those past 20 years, the CAT has been used for assessing the level of creativity of products in a wide range of domains, including musical composition (Hickey, 2001), poetry (Picariello, 1992), and artwork (Amabile, 1983). The CAT has been used and found to have acceptable levels of reliability for assessing the creativity of nonparallel products (i.e., published poems), which were developed in natural conditions and not under the conditions controlled by a researcher (Baer, Kaufman, & Gentile, 2004). However, in most cases, it has been used in research efforts in which participants were assigned identical tasks to create some type of product in a controlled environmental setting (Hennessey & Amabile, 1999). Table 2 depicts examples of previous ways that the CAT has been used in published research, showing the tasks and products evaluated and the resultant inter-rater reliabilities (Amabile, 1996). All except the ideas for high-tech products had inter-rater reliability rates of 0.73 or higher.

According to Amabile (1996), a task appropriate for use of the CAT to assess the creativity of the resulting product must meet three requirements:

1. The task must lead to some product or clearly observable response that can be made available to appropriate judges for assessment. The present research clearly met this requirement, as the officers developed military plans to submit.
2. The task should be open-ended enough to permit considerable flexibility and novelty in responses. The present research met this requirement, as the officers had great latitude in the development of the operational plans.
3. The task should not depend heavily on any certain specific skills, such as drawing ability or verbal fluency. The present research clearly met this requirement, as they all participants had access to the same tools and were all capable of using the appropriate computer software packages. Because participants submitted their statements and sketches rather than briefing their plans, rhetorical skills and demeanor did not influence the assessment.

Table 2.
Uses of Consensual Assessment Technique (CAT) for Evaluating Creativity

Source	Task / Product	Reliability
Pollak, 1992	Art students' portfolios	0.73
Amabile, Phillips & Collins, 1994	Art in various media	0.92
Hennessey, 1989	Computer line drawings	0.87
Amabile, Hennessey, & Grossman, 1986	Stories told to a picture book without words	0.83
Hill, 1991	Prose passages	0.88
Tighe, 1992	Poems of various styles	0.81

Conti, Amabile, & Pollak, 1995	Psychology essays	0.75
Conti & Amabile, 1995	Computer programs	0.75
Collins, 1992	Survival ideas	0.80
Collins, 1993	Ideas for high-tech products	0.61
Conti, 1992	Business solutions	0.80

Note. From *Creativity in Context* by T. M. Amabile, 1996, Boulder, CO: Westview Press. Copyright 1996. Adapted with permission of the author.

In addition to the considerations regarding the nature of the task, there are certain considerations concerning CAT judging. The judges should all be experienced in the domain, but their experience levels do not need to be identical (Amabile, 1996). The judges should not be selected on any criteria other than familiarity with the domain in question. The judges should be instructed to assess the level of creativity of each product against the others, as opposed to rating them against some ideal or standard. They should evaluate the products on at least one additional dimension besides creativity. They should also conduct their assessments independently, and with the samples presented in different orders (Amabile, 1996). The present research met all of these guidelines.

Overview of Judges for Consensual Assessment Technique

The researcher selected five individuals who served as judges to assess the levels of creativity of the subjects' plans. Descriptions of the judges follow.

1. Judge 1 was an Army intelligence officer, active duty colonel, with over 20 years of operational experience in the Army. He was a graduate of both schools within SAMS: the Advanced Military Studies Program (AMSP) and AOASF. He had

served as faculty at SAMS and had been selected for command of an Army brigade.

2. Judge 2 retired from the Army as a lieutenant colonel in 2000, and from that time until the present had served as the Director of the Advanced Operational Arts Studies Fellowship (AOASF). This fellowship is a op level school under SAMS where post-command Army officers are educated in preparation for service in positions supervising the planning staffs of Army divisions and corps. While on active duty in the Army, Judge 2 was a graduate of SAMS and served operationally as the lead planner for an Army Corps. He was an armor officer by specialty in the Army, and now has a Ph.D. in history.

3. Judge 3 was an Army Special Forces officer. He was an active duty lieutenant colonel with over 15 years of experience in the Army. He was a graduate of the Command and General Staff College and was currently assigned as a member of the SAMS faculty.

4. Judge 4 was a Marine Corps colonel, helicopter pilot, with over 25 years of service on active duty. He graduated from the SAMS fellowship in 2003 and he had served as the acting director of the school. He had extensive experience in operational assignments in the Marine Corps.

5. Judge 5 was an Army Special Forces officer with over 20 years of experience in the Army. He was also a graduate of both schools within SAMS, and had also served as faculty at SAMS. As a special forces officer, Judge 4 had extensive operational experience.

Although all five of the judges were highly familiar with the domain of military planning, which is the lone prerequisite for success offered by Amabile (1996), they had a wide variety of military experiences and specialties, as seen in Table 3. The judges each independently evaluated all of the military plans on their levels of creativity, feasibility, and suitability. The researcher prepared a separate binder for each of the judges in which each plan, appearing without any identifying marks as to the author's identity, was tabbed separately. The binders were prepared so that the order of the plans was different for each binder.

The judges each recorded the assessments on a Likert-type scale:

1 = Very uncreative

2 = Somewhat uncreative

3 = Neither creative nor uncreative

4 = Somewhat creative

5 = Very creative

Table 3.
Military Branch, Specialty, and Rank of the CAT Judges

Judge	Branch of Service	Military Specialty	Rank
Judge 1	Army	Intelligence	Colonel
Judge 2	Army	Armor	Lieutenant Colonel (ret)
Judge 3	Army	Special Forces	Lieutenant Colonel
Judge 4	Marines	Pilot	Colonel
Judge 5	Army	Special Forces	Colonel

Population

The population for this research was the body of officers attending the School of Advanced Military Studies at Fort Leavenworth, KS ($N = 104$). All members of the population were field grade officers, grades of 0-4 or 0-5, and over 85% were Army officers with the remainder being Navy, Marine, or Air Force officers.

Sample

The sample was a convenience sample, consisting of all officers attending SAMS who were present for duty on the day of the study. The sample size was $n = 66$. The sample differed from the population in that, due to the operational requirements of the Army, some the officers in the class had graduated early in order to deploy with their new units to Iraq or Afghanistan. Some of the officers in the class were on temporary duty at other posts and a few were unavailable due to academic necessities. All participants were current students, and all had been deployed to the combat theaters of either Iraq or Afghanistan during their previous assignments. The students at SAMS were organized into seven seminars, each with a colonel in charge as the seminar leader. The students each received the same yearlong curriculum, although they received all of their instruction SAMS in their own respective seminars. The officers who graduated early had not been selected due to any specific trait or ability, and there appeared no reason to believe that their absence reduced the representativeness of the sample.

Procedures

The present research was conducted at the U.S. Army School of Advanced Military Studies (SAMS) at Fort Leavenworth, Kansas. SAMS consists of two schools: the Advanced

Military Studies Program (AMSP) and the Advanced Operational Arts Studies Fellowship (AOASF). The AMSP is a professional military school in which a student body of predominantly Army majors is provided a yearlong education in preparation for their next assignments as planners for U.S. Army corps and divisions. The SAMS academic curriculum consisted of extensive readings and seminar level discussions reinforced by practical applications in which the officers assumed the role of military planning staffs and developed plans to provide courses of actions for military units to pursue in response to given real or hypothetical scenarios. All graduates of AMSP were awarded master's degrees in the military arts and sciences (MMAS). The sample for this study consisted of all AMSP students who were present for training and education on the day of the research. The demographics of the sample are in Appendix A.

During the week immediately preceding the research, the students all participated in an exercise in which they formed teams simulating the staffs of Army operational units. As these notional staffs, they were presented a scenario and a problem and required to conduct collaborative planning to develop and propose a plan of action. They developed courses of action for their respective military units and briefed their plans to members of the SAMS faculty. On the week following that exercise, students were presented with a modification to the previous scenario and assigned to work independently to develop individual operational plans. The scenario was different from what they had worked with during the previous week in three significant ways.

1. The chain of command was changed such that they had different types of forces under their charge, therefore providing them different military capabilities. The different capabilities made possible some operations that had not been possible

before, but also made infeasible some operations that had been previously possible.

2. The notional weather was significantly different from what they had previously planned for, which changed the capabilities of forces and weapons systems and the relative importance of various geographical areas.

3. The required objectives assigned by their notional higher headquarters were changed, which should have changed the operational focus.

In accordance with military doctrine, the students were required to develop both a narrative, called a *Course of Action Statement*, and a graphical representation of their plans, called a *Course of Action Sketch*. These plans were used by the school as part of the normal military education and mentoring of the officers. These plans were used by the researcher as the products from which the officers' levels of creativity were assessed.

The officers were not told the nature of the research until after they had completed and submitted their plans. This was to ensure that the officers each developed what they felt was the *best* plan possible to accomplish the assigned mission.

Data Collection

The study began at 0830 on the designated day with all subjects seated in the SAMS auditorium. The study was conducted throughout the day in four basic parts: the initial briefings and directions to the subjects all together, their planning work conducted independently, another briefing session conducted together, and their independent completion of the tolerance of ambiguity test under controlled conditions.

In the first session, the researcher provided an initial brief to all of the students at the same time. The researcher informed the students of their planning assignment, representing it as

part of their normal SAMS academic training. The researcher briefed all of the students on the scenario for the problem and answered any questions that they had at that time. After this collective briefing, the students were provided guidance on their requirements, and given forms on which to prepare their plans for submission so the plans were identical in format. They were then released back to their respective classrooms and given 4 hours to develop their plans.

At the completion of the 4 hours, and after the students had all submitted their plans, the researcher briefed them on the nature, purpose, and remaining procedures of the research. This was the first time they became aware that their plans would be assessed for creativity. The subjects were then informed of the voluntary nature of the research, specifically that the use of their plans for the purposes of this study and the following session in which they would take the tolerance of ambiguity tests would be completely voluntary. Their plans would still be used by their normal faculty in accordance with the scheduled curriculum and school policy, but their plans would be used for this research only if they provided consent. The students were briefed that no personally identifying information will be published in the results of the study. The students were then afforded the option of declining to participate. All of the students chose to participate in the study.

For the next session, with the subjects all seated in the auditorium, the researcher administered the MAT-50 (Norton, 1975). The researcher read the instructions aloud, provided writing instruments to the students, and started the students on the test. The students were given 20 minutes to complete the MAT-50. Following the expiration of the time, the researcher collected the tests from the subjects, which completed the data collection portion of the research.

The researcher then constructed a master binder containing all of the participants' operational plans and assigned each plan a control number. Following this, the researcher

prepared individual binders for each of the judges, with each binder containing copies of each of the participants' operational plans. All identification marks were removed, with the exception of the randomly assigned control number. The binders were constructed in a manner so the plans appeared in different orders in each binder. This was done to ensure that the judges' assessments were not affected by the order in which the plans appeared in their binders. The judges' binders included the form on which they subsequently recorded and submitted their assessments.

The researcher presented each judge with a binder and read aloud the directions. In keeping with the methods of Amabile (1996), the judges were directed, "Using your own subjective definition of creativity, rate the degree to which each [operational plan] is creative relative to the other [operational plans]" (p. 74). Due to the time required to read, reflect upon, and assess the creativity of all 69 plans, and the reality that the judges were performing this task voluntarily in addition to their normal duties, the researcher allowed judges 8 weeks to complete and submit their assessments. The decision to allot the judges an extensive amount of time to complete their work was partly driven by Amabile's (1996) findings that inter-rater reliability when using the consensual assessment technique was greatly affected by the degree to which the judges felt that they had ample time to inspect and reflect upon the works in question.

Data Analysis

The researcher used the Statistical Package for the Social Sciences (SPSS) to perform the data analysis. The analysis used to answer the primary research question was modeled after Stoycheva's (2008) study in which she identified a positive correlation between tolerance of ambiguity and creative motivation in Bulgarian students. The distribution of the independent variable was used to dichotomize the sample into two groups: one group with high ambiguity

tolerance and one with low ambiguity tolerance (see Figure 6). A *t* test was used to determine if the mean creativity scores differed between the two groups.

To answer the secondary research question, SPSS was used to determine Cronbach's coefficient alpha (α) as the statistic for measuring inter-rater reliability. Cronbach's alpha is both the most widely accepted statistic (Garson, 2008) and the statistic preferred by Amabile (1996) for measuring inter-rater (inter-judge) reliability. Cronbach's alpha ranges from -1.0 to +1.0, with an inter-rater reliability rating of 0, indicating that the instrument did not measure the true effect at all and only an error component was present (Garson, 2008). Conversely, a perfect inter-rater reliability measure of 1.0 would indicate that the instrument measured only effect, that is, each of the judges scored all of the plans exactly the same (Field, 2005; Garson, 2008). According to Garson (2008),

> By convention, a lenient cut-off of .60 is common in exploratory research; alpha should be at least .70 or higher to retain an item in an "adequate" scale; and many researchers require a cut-off of .80 for a "good scale." (p. 1)

Eysenck (2004) recommended 0.7 as a cut-off for having high confidence in the inter-rater/ inter-judge reliability of an instrument. Amabile (1996) acknowledged that although inter-rater reliability coefficients of 0.6 have been accepted for use in the social sciences, 0.7 is a good number to use as indicator of high reliability. The researcher used 0.7 as a minimum coefficient required for accepting the CAT as a sufficient tool for use in assessing the creativity of military operational plans.

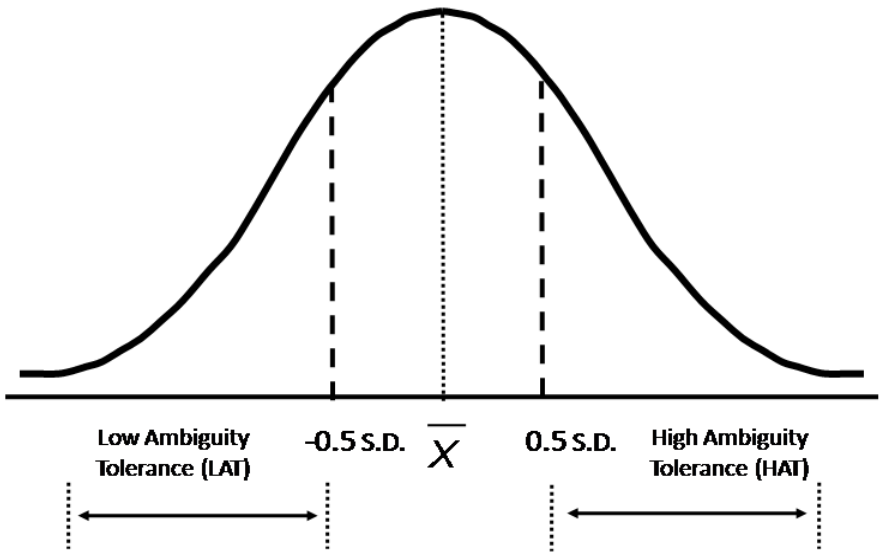

Figure 6. Dichotomization of the independent variable.
Dichotomization of the independent variable. Identification of High AT scores (0.5 S.D. above the mean) and Low AT scores (0.5 S.D. below the mean).

Protection of Human Rights

Approval for the study was granted by both the Kansas State University Institutional Review Board (IRB) and the U.S. Army Command and General Staff College (CGSC) Institutional Review Board (IRB) (Appendices C and D). Both CGSC and KSU IRBs approved of the research methods, the data to be collected, and the instruments used to collect the data.

To ensure anonymity of the subjects and to protect them from any potential damage, all identifying marks or labels were removed from the participants' operational plans prior to distributing them to the judges. Additionally, the student responses to the MAT-50 and all data were kept confidential. Data were not presented in a manner that compromised the subjects' confidentiality. All subjects were briefed verbally that participation in the study and provision of data was voluntary and were given opportunity to opt out of the study. No students declined to

participate. Although the officers' seminar leaders received copies of their military plans as part of the normal SAMS curriculum, the seminar leaders were not provided any data regarding the judges' assessments of the plans or the officers' tolerance of ambiguity scores. The researcher had no position of authority or evaluation over any of the participants.

Summary

The purpose of this study was to investigate whether a relationship exists between the levels of tolerance of ambiguity of the officers attending the U.S. Army School of Advanced Military Studies and the levels of creativity of the operational plans the officers developed. The nature of the operational environment in which military officers must function has become increasingly complex and ambiguous. The adversaries opposing the military forces have become increasingly adaptive and resourceful. If military leaders attempt to apply dogmatic, uncreative solutions to the new problems they face, in the opposition of an adversary who learns quickly, adapts, and anticipates, the solutions will likely fail. Faced with these realities, Army and Marine Corps leaders have called for increased creativity on the part of officers. By answering the primary and secondary research questions, results of this research can help guide efforts such as the refinement of human resources policies (e.g., officer selection and advancement policies) and the refinement of professional educational programs.

CHAPTER 4 - RESULTS

Overview

The results of the study are presented in this chapter. It opens with a discussion of the sample, followed by the results of the primary and secondary research questions. The details of the analysis that led to the results are discussed, beginning with the analysis of the reliability of the instruments used to measure the independent and dependent variables. The analyses of the hypotheses regarding the results of the primary and secondary research questions are discussed, and the results of the *post hoc* tests explained.

Demographics of the Sample

The sample for this research consisted of all students at the U.S. Army School of Advanced Military Studies present for duty on the day of the research. Present that day were 71 officers, although five participants missed either the individual planning session or the administration of the MAT-50 assessment, and therefore were not included in the sample. As a result, the sample consisted of 66 individuals. The population for the research consisted of the entire student body in the SAMS class of 2008: 103 military officers and one civilian. The officers who were not present had either graduated early to join their new units in preparation for deployment to Iraq and Afghanistan or were assisting the staff of one of the Geographic Combatant Commanders in the conduct of mission planning in support of ongoing operations in the Global War on Terror (GWOT). The officers who were not present due to early graduation and academic necessity were not selected on the basis of any capability or characteristic.

Therefore, there is no reason to believe their absence rendered the sample any less representative of the population. The sample is believed to be sufficiently representative of the population.

From the sample of 66 officers, 43 (65%) were U.S. Army officers. Of the remaining 23, 12 (18% of the sample) were officers in the Army Reserves, 4 (6% of the sample) were officers in the U.S. Air Force, 2 (3%) were in the National Guard, and 1 each was an officer in the U.S. Navy and the U.S. Marine Corps. Additionally, two officers in the sample were from allied militaries; one each from Australia and the Netherlands. Finally, one civilian was in the sample, who was an employee of the U.S. Agency for International Development.

The sample consisted of 61 males and 5 females (7.6%). The sample ranged in age from 32 to 54 years of age, with a mean age of 36 years old, and a standard deviation of 3.36. The sample ranged in the time participants had served in the military (or civilian organization) from a minimum of 10 years to a maximum of 25. The mean time in service for the sample was 14 years, with a standard deviation of just over 3 years.

Results

Primary Research Question

Primary research question: Is there a positive correlation between the levels of AT of students at SAMS at Ft. Leavenworth, KS, and the levels of creativity of the military plans they develop? The study results did not support the hypothesized correlation between the officers' AT and the creativity of their military plans. Contrary to the theoretical prediction, the correlation identified was $r = -0.099$. Not only was the correlation not statistically significant, but it was negative, indicating that the officers more tolerant of ambiguity tended to develop plans that were less creative. The null hypothesis could not be rejected, indicating that for this sample,

there was no positive correlation between the officers' levels of tolerance of ambiguity and the creativity of the military plans that they developed.

Secondary Research Question

Secondary research question: How effective is Amabile's (1983, 1996) Consensual Assessment Technique (CAT) for assessing the level of creativity of military plans? The inter-rater reliability of the five judges was found sufficiently high ($\alpha = .822$). Garson (2008) designated a Cronbach's alpha of 0.7 as the threshold for an acceptable scale, and 0.8 as the threshold for a good scale. The null hypothesis was rejected, indicating that the CAT is a good instrument for assessing the creativity of military plans.

Reliability Assessment of the Instruments

Consensual Assessment Technique (CAT)

The first step in the analysis was to assess the reliability of the instruments used to measure the dependent variable and the independent variable. The dependent variable, the level of creativity of the officers' military plans, was measured using Amabile's (1983, 1996) consensual assessment technique (CAT), in which five judges familiar with the domain of military planning each independently rated all 66 military plans based upon their levels of creativity. The individual distributions of each judge's scores can be seen in Table 4. The judges gave each plan a creativity score ranging from 1 to 5, with a score of 5 being the most creative. Judges 2 and 4 tended to group the scores in the middle, giving scores of 2, 3, or 4 to 85% and 82% of the plans, respectively. Judge 1 awarded scores in a more rectangular distribution. Judge 3 and judge 5 were much tougher graders, giving 17 plans each the lowest possible score for creativity, while awarding the highest possible scores to only four plans and one plan,

respectively. Plans awarded the lowest possible score outnumbered those awarded the highest possible score by nearly a 3-to-1 ratio (see Table 4).

Table 4.
Creativity Scores Awarded by Judges

	Creativity Scores Awarded							
Judge	1	2	3	4	5	*M*	*SD*	Variance
Judge 1	17	15	12	11	11	2.76	1.44	2.06
Judge 2	6	20	13	23	4	2.98	1.13	1.28
Judge 3	17	15	16	14	4	2.59	1.23	1.57
Judge 4	9	20	19	15	3	2.74	1.10	1.21
Judge 5	17	15	14	19	1	2.58	1.20	1.45
Total	66	85	74	82	23	2.73		

As seen in Table 4, judges 3 and 5 had similar distributions of creativity scores, with means of 2.59 and 2.58 and standard deviations of 1.25 and 1.20, respectively. Judges 1 and 4 also had similar means at 2.76 and 2.74, respectively, although their standard deviations were quite dissimilar. Judges 2 and 4 tended to group their scores much more tightly than the other judges did. Judge 2 gave only four plans the highest score possible, but was still had the highest mean creativity score at 2.98, and the second smallest variance, at 1.277.

The inter-rater reliability of the judges was determined to be acceptable with $\alpha = 0.82$, demonstrating that through their independent assessments, the judges agreed, to a significant degree, on which of the plans were creative and which were not. At this point, with a Cronbach's alpha coefficient significantly higher than the 0.70 standard, the researcher can answer the secondary research question by saying that the data supported the hypothesis that the CAT is an acceptable instrument with which to measure the levels of creativity of military plans.

MAT-50

An analysis of the internal reliability of the MAT-50 was performed using SPSS. The initial Cronbach's alpha for the MAT-50 was 0.85, which, although lower than the .88 that Norton (1975) found during his research, indicated an acceptable level of internal reliability. However, eight items were identified by SPSS to have insufficient inter-item correlation with the rest of the instrument, resulting in decreased overall internal reliability of the instrument. Four of the eight items flagged by SPSS for insufficient inter-item correlation came from the *Art Forms* subscale. The resultant 53-item short version of the MAT-50 had an internal reliability rating of 0.87 (see Table 5).

The researcher removed these eight questions and performed another reliability analysis. This method mirrors the method that Stoycheva (2008) used to develop the short version of the MAT-50 that she utilized in her research. With these eight items removed, the Cronbach's alpha for the shortened MAT-50 with 53 items rose slightly to $\alpha = .87$.

The second reliability analysis identified two additional items that would further improve the statistical internal reliability of the instrument by their removal. With the two additional items removed, the shortened version of the MAT-50 now consisted of 51 items. The reliability analysis of this 51-item version of the MAT-50 yielded a Cronbach's alpha of .88. SPSS identified no additional items whose removal would improve the internal reliability. The researcher therefore used the 51-item version of the MAT-50 for the analysis of correlation between tolerance of ambiguity and creativity.

Table 5.
Items Removed from MAT-50 to Improve Internal Reliability

Item Removed	Item Wording	Subscale of MAT-50
Initial items 1	Almost every problem has a solution	Philosophy
4 [a]	I do not believe that in the final analysis there is a distinct difference between right and wrong	Philosophy
8	I tend to be very frank with people	Interpersonal Communication
51[a]	I am tolerant of ambiguous situations	Habit
53	I tend to like obscure or hidden symbolism	Art Forms
54	Mysticism is too abstract and undefined for me to take seriously	Art Forms
55	If I miss the beginning of a good movie, I like to stay to see the start of it	Art Forms
56 [a]	Vague and impressionistic pictures appeal to me more than realistic pictures	Art Forms
Final items 59[a]	Generally, the more meanings a poem has, the better I like it	Art Forms
60	A poem should never contain contradictions	Art Forms

[a]Items reversed for scoring.

The number of items removed from Norton's (1975) original MAT-50 to maximize the instrument's internal reliability is similar to the number removed by Stoycheva (2008) during her research into the relationship between tolerance of ambiguity and creative motivation, and the resultant internal reliability of the present research is similar to with the Stoycheva results after modifying the MAT-50 (Table 6). Of the 10 items removed by this researcher from Norton's

(1975) original MAT-50, two were removed from the Philosophy subscale, one from the Interpersonal Communication subscale, one from the Habit subscale, and six from the Art Forms subscale. None was removed from the subscales of Public Image, Job Related, Problem Solving, or Social. Table 6 shows how the distribution of items in the resultant 51-item short version used in the present research compared with the 52-item short version utilized by Stoycheva (2008).

Table 6.
Distribution of Items in Subscales of MAT-50

Subscale	MAT-50 Version			
	Norton Original	Stoycheva Short Version	51-item Present Study	
	n	*n*	*n*	%
Philosophy	7	6	5	9.80
Interpersonal Communication	5	2	4	7.84
Public Image	4	4	4	7.84
Job Related	5	5	5	9.80
Problem Solving	9	7	9	17.65
Social	9	9	9	17.65
Habit	13	11	12	23.53
Art Forms	9	8	3	5.88
Total	61	52	51	100.00

The majority (60%) of the items removed from the MAT to improve its internal reliability came from the Art Forms subscale. In fact, two thirds of all of the items in the Art

Forms subscale were found to have insufficient inter-item correlation with the rest of the instrument to warrant inclusion.

Exploration of the Data

The overall creativity scores for the military plans were determined by summing the ratings given by the judges. Creativity of the officers' military plans was assessed using the consensual assessment technique. The highest possible score, if all five judges gave plan the highest allowable score of 5, was 25. The lowest possible score was 5. AT scores in the present study were assessed using a shortened version of MAT-50. The highest possible (most tolerant of ambiguity) score was 255, and the lowest possible score was 51. The distribution of the overall creativity scores can be seen graphically in Figure 7. The mean creativity score is 13.65, with a standard deviation of 4.702. The creativity scores for all of the officers can be seen in Appendix D. A visual inspection of the distribution of the creativity scores depicted in the histogram (Figure 7) reveals the distribution to have a right tail and to be flatter than normal.

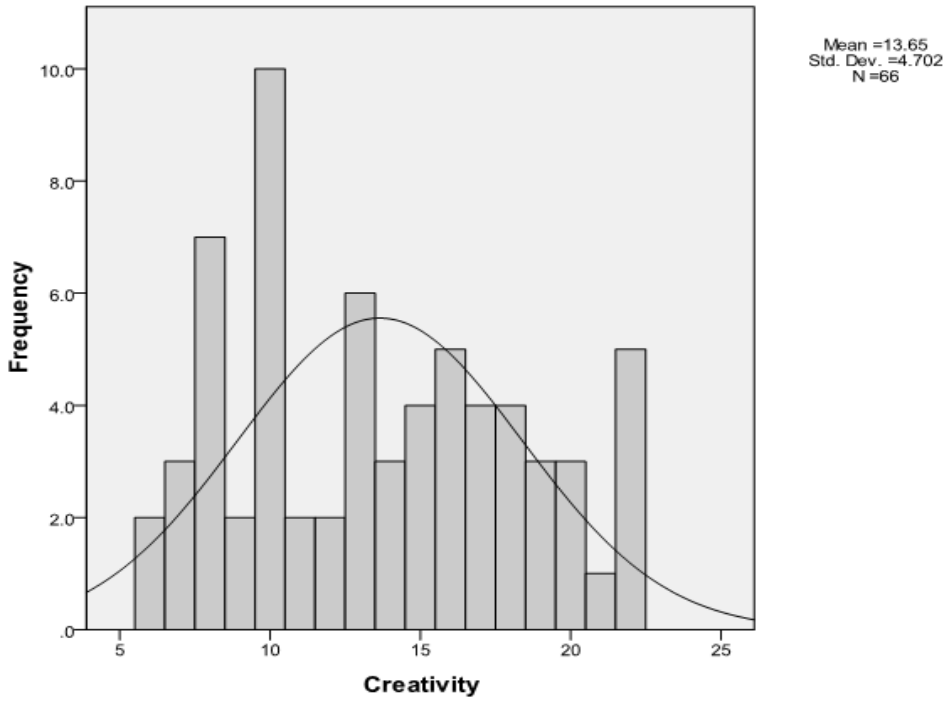

Figure 7. Distribution of creativity scores of the military plans

These assessments are supported by the descriptive statistics (see Table 7), which show the creativity distribution to have a skewness statistic of .20 and a kurtosis statistic of -1.10. Converting these to *Z* scores results in a *Z* skewness =.678 and a *Z* kurtosis = 1.88, both of which mean that the distribution of the overall creativity scores can be treated as a normal distribution.

Table 7.
Descriptive Statistics for Creativity and Tolerance of Ambiguity (AT) Scores

	Creativity	AT
Mean	13.65	154.15

Standard deviation	4.70	19.95
Skewness	.20	-.022
Std. error of skewness	.30	.30
Kurtosis	-1.10	-.49
Std. error of kurtosis	.58	.58
Range	16	91
Minimum	6	109
Maximum	22	200

Analysis of Correlation

Following Stoycheva's (2008) methodology, the primary research question was answered by dichotomizing the independent variable of tolerance of ambiguity into categories of high tolerance of ambiguity (HAT) and low tolerance of ambiguity (LAT). The mean levels of creativity between the HAT and the LAT groups were compared using an independent means *t* test. The participants were grouped into three categories according to their scores on the short version of the MAT-50. Those individuals with tolerance of ambiguity (AT) scores greater or equal to half of one standard deviation above the mean were designated as HAT individuals; those with AT scores less than or equal to half of one standard deviation below the mean were designated as LAT individuals; and those in the middle were designated as medium ambiguity tolerant (MAT) individuals.

This resulted in having 24 HAT individuals and 24 LAT individuals. The HAT individuals had a mean AT score of 174.83 and a standard deviation of 9.61. The maximum AT score possible on the 51-item short version of the MAT-50 was 255, and the highest AT score in

this study was 200. The LAT individuals had a mean AT score of 137.95 with a standard deviation of 10.11. The minimum possible score on the 51-item version of the MAT was 51, and the minimum score in this study was 109.

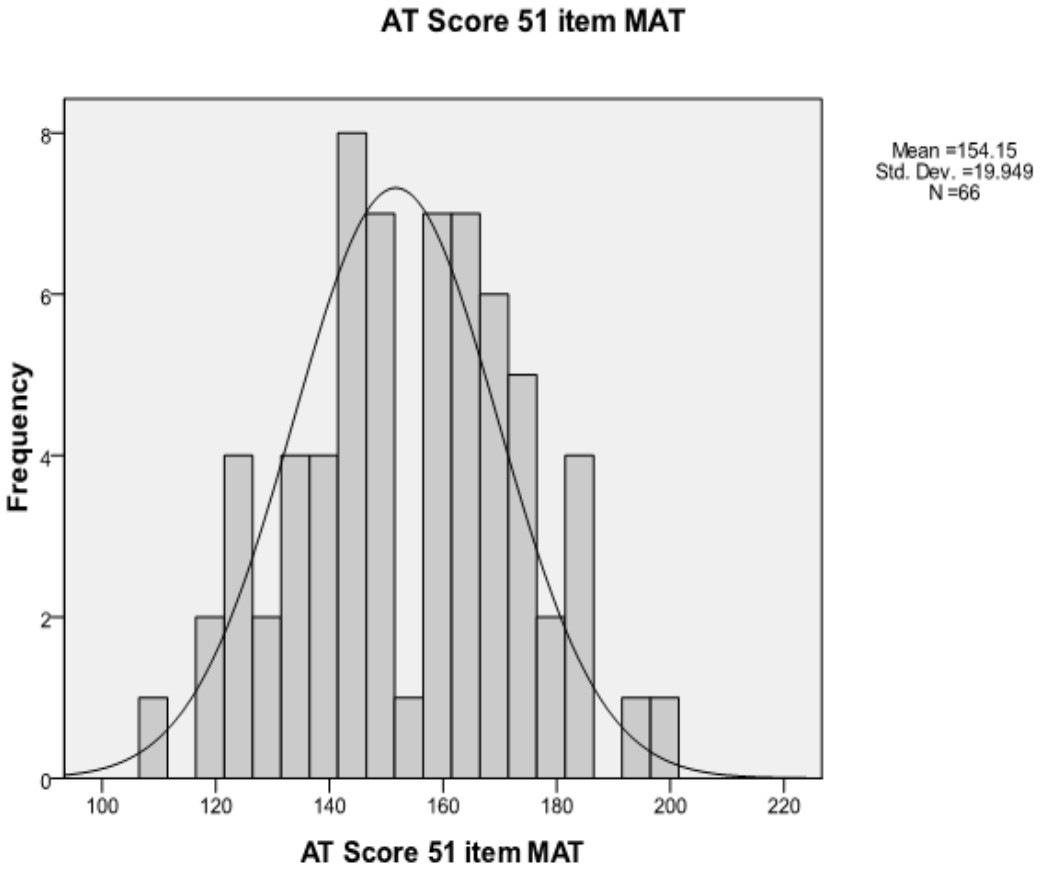

Figure 8. Distribution of tolerance of ambiguity scores.
Distribution of tolerance of ambiguity scores. Higher scores indicate a greater tolerance for ambiguity. The maximum possible score was 255, and the minimum possible score was 51.

The distribution of all tolerance of ambiguity scores can be seen graphically in Figure 8. The mean of the AT scores was 154.15 and the standard deviation was 19.95. Other than the small number of scores just beneath the mean, the distribution appeared visually to be very close

to normal. The descriptive statistics indeed indicated a very small negative skewness (-.022) to the distribution and a slight flatness (-.492 kurtosis statistic) (Table 8). Converting these to *Z* scores resulted in a *Z* skewness =.07 and a *Z* kurtosis = 0.85, both of which meant that the distribution of the AT scores could also be treated as a normal distribution.

Table 8.
Descriptive Statistics for High AT (HAT) and Low AT (LAT) Groups

	High AT (HAT)	Low AT (LAT)
Mean AT	174.83	133.21
Standard Deviation	9.61	9.94
Sample Variance	92.41	98.78
Kurtosis	1.03	-0.32
Skewness	1.21	-0.76
Range	35	35
Minimum	165	109
Maximum	200	144
Count	24	24

It was hypothesized that creativity would be positively correlated with tolerance of ambiguity. To test this hypothesis, an independent means *t* test was performed to determine if the mean creativity level of the military plans developed by the HAT individuals was significantly higher than it was for the LAT individuals. The *t* test revealed that the data did not support the hypothesis. As seen in Table 9, the mean creativity level for the HAT individuals was actually lower than that of the LAT individuals (13.17 to 13.96). The standard deviations of the two

groups were similar, with the LAT group having greater variation in creativity scores than the HAT group (see Table 9).

Table 9.
Comparison of Creativity Scores for HAT and LAT Groups

Group	*M*	*SD*
HAT group	13.17	4.37
LAT group	13.96	5.06

Therefore, the null hypothesis for the primary research question could not be rejected. The data did not support the hypothesis that military plans developed by individuals with higher levels of tolerance of ambiguity would be more creative than were those developed by individuals with lower levels of tolerance of ambiguity. Given the amount of theoretical support for the hypothesized positive correlation between tolerance of ambiguity and creativity, the researcher then sought to identify possible reasons for the unexpected result of this study. The first step was to check the statistical power of the analytical tests conducted (see Table 10).

Table 10.
Results of t *test for LAT and HAT groups* (p = *.05)*

	F	Sig.	*t*	*df*	Sig. 2-tailed	*M* Diff.	*SE* Diff.	Lower CI	Upper CI
Equal variances assumed	.303	.585	-.580	46	.565	-.792	1.365	-3.539	1.956
Equal variances not assumed			-.580	45.046	.565	-.792	1.365	-3.541	1.957

Statistical Power Analysis

The power of a statistical test is simply, "the probability that the test will correctly reject the null hypothesis" (Rossi, 1990, p. 646). Because the analysis of the data suggested that, for this study, the null hypothesis could not be rejected, it was important to understand the likelihood of the event that the result was due to the absence of a relationship and not to a lack of statistical power of the test utilized.

Cohen (1977) recommended that statistical tests should have a power rating of .80. For this design, an independent means *t* test, with $p = .05$, one-tailed (due to directional hypothesis) with a sample size of 66 resulted in a statistical power to find an effect of medium size ($r = .3$) of only .53, which meant this test had only slightly over a 50% chance of detecting a medium-size effect, even if one had been present (Cohen, 1977). Looking for a medium effect ($r = .3$) was important because, as Mischel (1968) pointed out, an effect of very much greater than .3 is rarely encountered in personality research, and an effect of less than .3 is relatively trivial for any sort of real application. Because the size of effect and the $p = .05$ level were both set by convention, the sample size was the only variable that could have been altered to get the desired power level using this statistical analysis method. Unfortunately, the sample size was smaller than anticipated and could not be increased, due to the unanticipated early graduation requirements and other commitments of SAMS students based on the Army's wartime operational necessities.

This method of dichotomizing the independent variable has been used often in psychology research (MacCallum et al., 2002). MacCallum et al. conducted a meta-analysis and found it used in 110 of 958 articles published in three major psychology journals, the *Journal of Personality and Social Psychology*, the *Journal of Consulting and Clinical Psychology*, and the *Journal of Consulting Psychology*, over a 2-year period from 1998–2000. Although it has been

widely used in comparable research, this method of statistical analysis in which the independent variable is dichotomized resulted in an unacceptable sacrifice of statistical power (MacCallum et al., 2002). The researcher therefore conducted an additional analysis of the data, computing a Pearson's coefficient of correlation to gain additional confidence in answering the primary research question. This test, with the sample size of 66 and $p = .05$, achieved the conventional threshold for statistical power of .80 required to find a medium effect ($r = .3$) (Cohen, 1977).

Pearson's Correlation Coefficient

A traditional scatter plot was produced which confirmed graphically what the *t* test found earlier; that no significant correlation existed between the two variables (Figure 9). A statistical analysis of the relationship between these variables resulted in $r = -.099$ (see Table 11), which was neither significant nor in the predicted positive direction. This test had an acceptable level of statistical power, and it confirmed the earlier finding that the data did not support the rejection of the null hypothesis in this case. Therefore, the answer to the primary research question was that this study did not support a finding that the military plans developed by officers with high levels of tolerance of ambiguity were more creative than were those developed by officers with lower levels of tolerance of ambiguity.

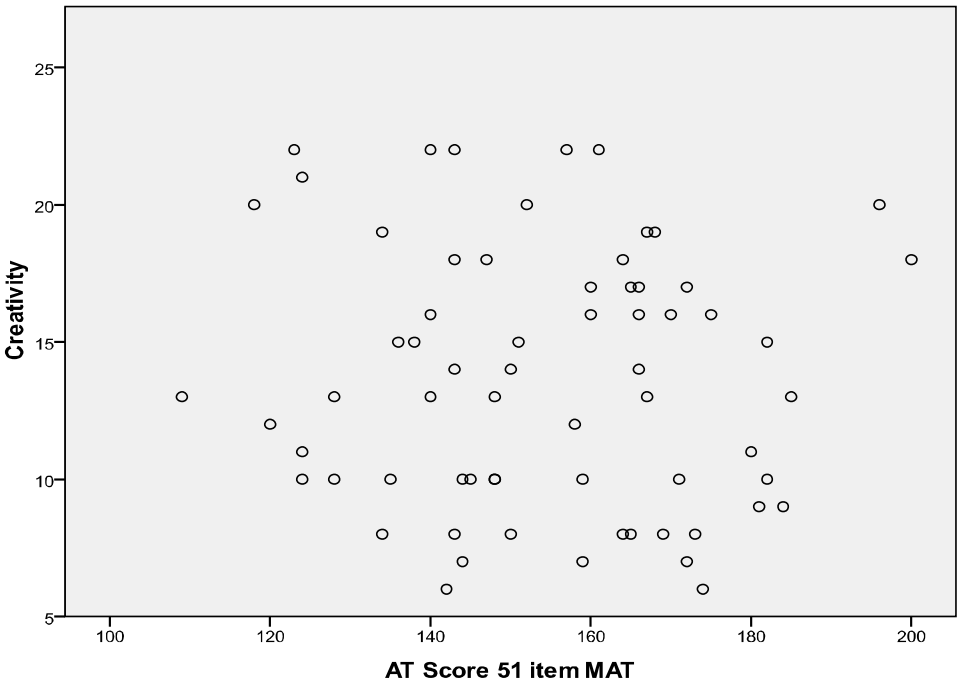

Figure 9. Scatterplot of creativity vs. AT scores.

Table 11.
Pearson's Coefficient of Correlation between AT and Creativity

	Creativity			AT		
	r	Sig. (1-tailed)	*N*	*r*	Sig. (1-tailed)	*N*
Creativity	1		66	-.099	.215	66
AT	-.099	.215	66	1		66

Because there was no significant correlation–and the minor correlation that was found to be negative—between the tolerance of ambiguity levels of the officers and the creativity of their military plans, analysis was conducted to determine if there was correlation between some, but not all, of the MAT-50 subscales and creativity. It was possible that the creativity of the officers' plans was positively correlated with certain subscale scores and not correlated with others. A statistical analysis revealed no significant correlations between tolerance of ambiguity as

recorded by any of the MAT-50 subscales and the creativity of the military plans. It is noteworthy, however, that four of the subscales had negative correlations and four had positive correlations (see Table 12).

Table 12.
Pearson Correlations between MAT-50 Subscales and Creativity

MAT-50 Subscale	*r*	sig. (1-tailed)
Philosophy	0.01	0.469
Interpersonal Communication	-0.113	0.183
Public Image	-0.199	0.054
Job Related	0.039	0.379
Problem Solving	0.088	0.241
Social	-0.114	0.182
Habit	-0.049	0.348
Art Forms	0.079	0.264

Finally, a correlational analysis was performed to explore the relationships between the officers' responses on each of the individual items on the MAT-50 and the creativity of their plans. Of the 51 items of the short version of the MAT-50, two had significant negative correlations with creativity: one from the Habit subscale and one from the Public Image subscale. The only item of the MAT-50 that had significant positive correlation to the creativity scores was item 27. This item appeared to capture the gist of military planning and decision-making (see Table 13).

Table 13.
Items Having Significant Correlations with Creativity

Item	Subscale	Item	*r*
16	Public Image	It bothers me when I don't know how strangers react to me.	-.254*
27	Problem-Solving	In a decision-making situation in which there is not enough information to process the problem, I feel very uncomfortable.	.272*
42	Habit	I will not consider buying an item unless the price is clearly marked on it.	-.285*

*$p < .05$

Summary

In summary, the findings of this study did not support the hypothesis for the primary research question, which anticipated a positive correlation between officers' tolerance of ambiguity levels and the creativity of the military plans they developed. There was, instead, a small negative correlation between tolerance of ambiguity and creativity, indicating that, on average, officers with lower levels of tolerance of ambiguity tended to produce plans that were more creative.

The data did support the hypothesis for the secondary research question and indicated that the CAT was an adequate instrument for assessing the levels of creativity of military plans. Chapter 5 contains discussion of the results in greater depth, possible reasons for the disconfirmation of the hypothesis for the primary research question, discussion of the implications of these results, and recommendations for future research.

CHAPTER 5 - SUMMARY AND DISCUSSION

Overview

The purpose of this research was to determine if there was a relationship between the levels of tolerance of ambiguity (AT) and the levels of creativity of the military plans developed by officers attending the U.S. Army's School of Advanced Military Studies. Although such a correlation between tolerance of ambiguity and creativity has been widely theorized (Amabile, 1983, 1996; Barron & Harrington, 1981; Cropley, 1999a; MacKinnon, 1978; Piirto, 2004; Rogers, 1959; Sternberg, 1999), the empirical results have been mixed. Despite the number of works theorizing a relationship, to date little empirical research was conducted into the relationship between tolerance of ambiguity and creativity (Albert & Runco, 1999; Barron & Harrington, 1981, El-Murad & West, 2004; Howard, 2006).

Researching the relationship in France, Zenasni et al. (2008) empirically found a positive correlation between tolerance of ambiguity and creativity in parents and children. In contrast, research in India by Pestonjee et al. (1999) found no significant correlation between tolerance of ambiguity and creativity in individuals serving in managerial roles in public and private sectors. Additionally, no research has been published to date that investigates such a relationship in the domain of military planning and decision-making. The present study was designed to fill this void by exploring the relationships between the levels of tolerance of ambiguity and creativity of the officers attending the U.S. Army School of Advanced Military Studies (SAMS).

Limitations of the Study

The following limitations applied to this study. The sample size was smaller than anticipated. Due to the immediate needs of the Army operational forces, a number of the SAMS students had graduated ahead of schedule in order to deploy to combat with their joining units, and they were unavailable to participate in the study. As with all correlational research, the study was designed to identify existing associations between the variables in question, but it was not designed to determine a causal relationship between them.

Restatement of the Problem

The United States is at war, and the leaders of the U.S. Army and the U.S. Marine Corps, the organizations charged with fighting and winning the ground battles of this war, have expressed a need for greater creativity on the part of their officers (Brown, 2007). While many theorists have predicted a significant positive correlation exists between individuals' levels of tolerance of ambiguity and their creativity (Amabile, 1983, 1996; Rogers, 1959; Sternberg, 1988, 1999; Taylor & Barron, 1963; Urban, 2003; Zenasni et al., 2008), few empirical studies have tested this theoretical correlation, and none of the studies was conducted in the domain of military planning (Tegano, 1990; Zenasni et al., 2008). Because creativity is to a large extent domain-specific (Baer, 1998; Sternberg, 1999), it is important for empirical research to be conducted to explore the theoretical relationship between tolerance of ambiguity and creativity, specifically in the domain of military planning.

Review of the Methodology

This study was a quantitative correlational analysis in which the researcher measured the two variables without attempting to manipulate either (Campbell & Stanley, 1963). The dependent variable for this study was the creativity of the officers' military plans, and the independent variable was the officers' levels of AT. The dependent variable was measured using the consensual assessment technique (CAT) (Amabile, 1983, 1996; Baer et al., 2004; Hennessey & Amabile, 1999; Hickey, 2001; Kaufman, Lee, Baer, & Lee, 2007), and the independent variable was measured using Norton's (1975) MAT-50.

The officers were given a notional military scenario in which they assumed the role of the lead planners for the staff of a Combined Joint Force Land Component Command of a U.S. Joint Task Force and had to develop a military plan to accomplish the command's assigned mission. The officers independently developed individual military plans, producing course of action statements and sketches. Following this exercise, the officers completed a shortened version of Norton's (1975) MAT-50 to assess their levels of AT. The shortened version of Norton's (MAT-50) used to measure the officers' AT levels consisted of 51 items, with 10 of the original 61 items removed in order to optimize the instrument's internal reliability ($\alpha = .877$).

The CAT was utilized to measure the creativity of the officers' military plans due to the difficulty in quantitatively measuring a concept as complex as creativity (Amabile, 1983, 1996; Baer et al., 2004; Hennessey & Amabile, 1999; Hickey, 2001; Kaufman, et al., 2007; Sternberg, 1999). In the present study, the CAT was performed by five judges who individually assessed the plans for their levels of feasibility, suitability, and creativity using a 5-point Likert-type scale.

Discussion of Findings and Conclusions

Primary Research Question

The primary research question was "Is there a positive correlation between the levels of AT of students at SAMS at Ft. Leavenworth, KS, and the levels of creativity of the military plans they develop?" The study results did not support the hypothesized correlation between the officers' AT and the creativity of their military plans. Contrary to the theoretical prediction, the correlation identified was $r = -0.099$. The correlation was not statistically significant, but more interestingly, it was negative. On average, the officers with higher levels of tolerance of ambiguity tended to develop plans that were *less* creative.

By failing to support the theoretical prediction, the empirical results presented the researcher with what Greenwald and Ronis (1981, p. 131) called a "disconfirmation dilemma." Faced with such a situation, the researcher next attempted to identify whether the failure to support the theoretical prediction was caused by a flawed methodology (operational disconfirmation) or flawed theory (conceptual disconfirmation) (Greenwald & Ronis, 1981).

Following discussion of the results of the secondary research question, the next sections of this chapter review the study's methodology and theoretical basis to determine the likelihood of each being the cause for the unanticipated results. Because of the wide array of potential topics, recommendations for future research are introduced as the topics are discussed rather than waiting to list them at the end, as is sometimes customary. The chapter concludes with a discussion of the implications of the present research and a summary of the recommendations for future research in the field.

Secondary Research Question

The secondary research question was "How effective is Amabile's (1983, 1996) Consensual Assessment Technique (CAT) for assessing the level of creativity of military plans?" The five judges used in this study all had extensive military experience, including education and experience in the domain of planning. Of the five, one was a pilot, one was an armor officer, one was a military intelligence officer, and two were in the Special Forces. Four of the judges were Army officers, and one was a Marine. Four were still on active duty and one was retired and is now the Director of the Army's Advanced Operational Arts Studies Fellowship. The inter-rater reliability of the five judges was found sufficiently high ($\alpha = .822$). Garson (2008) designated a Cronbach's alpha of 0.7 as the threshold for an acceptable scale, and 0.8 as the threshold for a good scale. The study therefore found the CAT a good method for assessing the creativity of military plans.

Methodological Issues

In this section, the methodology is reviewed to assess the likelihood that flawed methodology is the cause of the study's disconfirming results. The review of the methodology begins with the analysis of the data and progresses backwards to examine the measurement of the variables and ultimately the sample.

Analysis of the Data

All of the statistical tests were performed using SPSS. The initial analytical test was completed by dichotomizing the independent variable (AT scores) into Low AT and High AT groups, and subsequently using an independent measures *t* test to compare the means of the dependent variable (creativity scores of the military plans) of both groups. This follows the

method of analysis that Stoycheva (2008) used to find a positive correlation between tolerance of ambiguity and creative motivation. However, given the smaller sample size of present study (n = 66), the statistical power of the test was found to be only 0.53 (Cohen, 1977).

When this test showed no relationship between AT and creativity in the present study, a test with an increased statistical power was performed. The second analytical test, with a level of statistical power to determine a medium sized effect of .80 (Cohen, 1977), again produced disconfirming results. Despite the test's level of statistical power falling within the bounds of convention for accepted social science research (Cohen, 1977), it left a .2 chance that the test failed to identify an effect that was, in fact, present. This led to the first recommendation for future research; that the study be repeated using a sample size of at least 118. Using the same statistical test, such a sample size would yield a 95% chance of detecting a medium sized effect if it were present (Cohen, 1977).

Variables Measured

Dependent Variable: Creativity

The next step in the review was to reexamine the instruments used to collect data for both variables, starting with the instrument used to assess the creativity of the officers' military plans, the CAT. As mentioned above, the CAT was found to have an inter-rater reliability of .82, which is well above the conventional threshold of acceptability of .7 (Amabile, 1996). The distribution of the creativity scores was adequate, with a mean of 13.65 (average score of 2.75 per judge) and a standard deviation of 4.70. The lowest creativity score awarded to any individual was a 6, meaning four of the five judges gave the individual a 1, the lowest possible score, with the remaining judge giving the individual a 2. The highest score was 22, three points short of the

maximum possible. Through independent assessment of the plans, with each judge having the plans presented in a different order, the judges agreed to a significant degree on which plans were creative and which were not creative. It was therefore assumed that the disconfirmation was not the result of flawed measurement of the dependent variable.

Independent Variable: Tolerance of Ambiguity

Norton's (1975) MAT-50 has 61 items, grouped into eight subscales by theme. The analysis of the data revealed that 10 of the items lacked sufficient correlation with the others and that the internal reliability of the MAT-50 (originally $\alpha = .85$) would be improved if these items were removed. Upon removal of the 10 items, the internal reliability was increased slightly to $\alpha = .88$. Table 14 compares percent of items by subscale that lacked sufficient inter-item correlation with percent expected if distribution were random. Expected random distribution numbers were calculated using Pearson chi-square analysis. It is of interest that six of the items removed came from the same subscale, Art Forms (see Table 14). There are a few potential explanations for the uneven distribution of these six items. Results of a chi-square test indicated the probability that the distribution of the items was the result of chance was .007, ($X^2(0.01, 7) = 18.47531$). With Chi squared significant at the p=.01 level, the researcher could reject the null hypotheses and consequently the researcher assumed that the distribution was the result of something other than chance. The significant number of the items removed from the Art Forms subscale could be the result of participant apathy, which could itself be caused by the instrument length, the content of the items, or a combination of both.

Drolet, Butler, and Stevens (2009) found that perceived excessive instrument length or repetitive nature could lead to participant fatigue, apathy, and lack of effort. It is possible that by the time that the officers reached the Art Forms subscale, they had simply lost interest and

provided answers without due reflection and consideration. It is also possible that the officers perceived the Art Forms items as lacking relevance and they became cognitively disengaged.

Finally, it is possible that the allotted time available was insufficient. In the pilot study, all of the participants had completed the MAT-50 in 15 minutes. The researcher allotted 20 minutes for the officers to complete the instrument during the actual study. At the end of the 20 minutes, the researcher asked the group of officers if anyone required additional time, and none answered in the affirmative. However, it remains a possibility that as they got to the final subscale, some or all of the officers perceived that they were running short on time and provided responses without giving the items due thought and reflection. Therefore, an additional recommendation for future research is to conduct a study to see if the results on the MAT-50 would be different if the items were presented in a different order and with no time limit.

Table 14.
Distribution of Items Removed from MAT-50 for Insufficient Inter-item Reliability

Subscale	Order of Appearance	Item Count in Subscale	Items Removed		
			n	%	Expected %
Philosophy	1	7	2	28.57	1.15
Interpersonal Communication	2	5	1	20.00	0.82
Public Image	3	4	0	0.00	0.66
Job-Related	4	5	0	0.00	0.82
Problem-Solving	5	9	0	0.00	1.48
Social	6	9	0	0.00	1.48
Habit	7	13	1	7.69	2.13
Art Forms	8	9	6	66.67	1.48

Whether the uneven distribution of poorly correlating items was caused by randomness, insufficient time allotted, or participant apathy, the removal of the items cannot be labeled as the cause for the overall disconfirmation of the study's theoretical prediction. This is evidenced by two facts: First, the officers' scores on the full MAT-50 correlated highly with their scores on the short 51-item version ($r = .98$, $p < .01$). Second, the officers' AT scores using the full MAT-50 have a small *negative* correlation with their creativity scores ($r = -.060$).

Therefore, the disconfirmation was not the result of flawed measurement of the independent variable. Having explored the potential problems with the study's method, the next step was to reexamine the theoretical basis of the prediction to assess the probability that the results were caused by conceptual disconfirmation. The next section explores the possibilities that the theoretical positive relationship between AT and creativity is either non-existent or is more complex than previously thought.

Theoretical Issues

Domain Specificity of Tolerance of Ambiguity (AT)

One potential explanation for the null findings of the present study is that AT is domain-specific. As mentioned earlier, Budner's (1962) definition of AT centered on whether an individual felt threatened by ambiguous situations and stimuli. Perhaps the concept of AT is more complex than this. In certain domains, an individual may become distressed by ambiguous situations, while in other domains the same individual may feel challenged or positively stimulated by the same ambiguous situations. Examining how the officers as a whole responded to the various items of the MAT-50, an interesting pattern emerged. As Figure 10 depicts, the officers' collective responses differed significantly by subscale. The officers were, on average,

the most tolerant of ambiguity in the public image and problem solving subscales, implying that the officers' tolerance of ambiguity levels depended to some degree on the theme of the subscale.

Looking further into the results from the correlational analysis, the only item of the MAT-50 with a significant positive correlation with the officers' creativity scores was Item 27: "In a decision-making situation in which there is not enough information to process the problem, I feel very uncomfortable." In other words, the officers who produced the least creative plans tended to report that they felt uncomfortable making decisions when they felt they lacked information. This item seemed to capture the essence of military planning. The reality in military planning situations is that many unknowns are present, not the least of which are the capabilities, understanding, objectives, and intent of the enemy. That this particular item of the MAT-50 was the only one having a significant positive correlation with the creativity levels of the officers' plans suggested that AT is domain-specific. Therefore, it is recommended that future research be conducted with the objective of developing an instrument to measure AT specifically in the domain of military planning and decision-making.

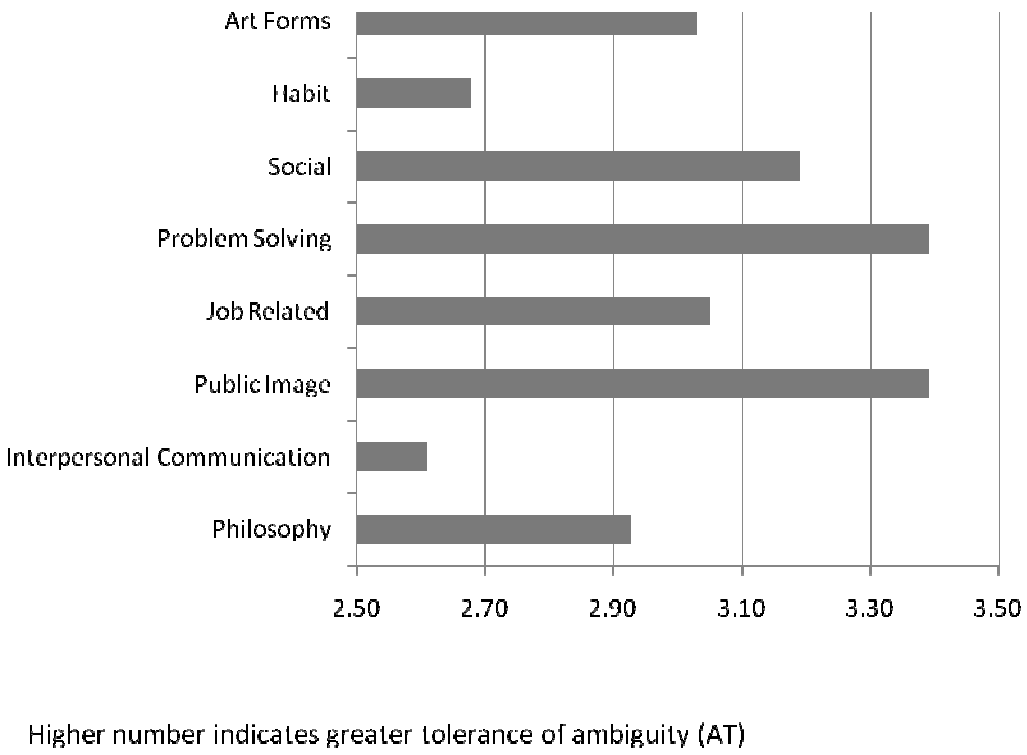

Figure 10. Average response on MAT-50 by subscale

Tolerance of Ambiguity as a State

Another possible explanation for the disconfirming results of this study was that AT is a state rather than a trait. In this context, a state is a temporary condition such as being angry, whereas a trait is a stable characteristic such as being irascible (Chaplin, John, & Goldberg, 1988). It is possible that AT is more of a temporary or learned condition than a stable, enduring trait. Table 15 shows the specific items for which the officers' average responses had the lowest (least tolerant of ambiguity) scores. Upon inspection, with knowledge of the military culture in which these officers had been immersed for an average of 14.3 years, and the SAMS curriculum to which these officers had been exposed over the past 10 months, a pattern appeared to emerge.

Table 15.
MAT-50 Items with Lowest (Least Tolerant of Ambiguity) Average Scores

Item No.	Item Wording	Mean Response
10	I really dislike it when a person does not give straight answers about himself.	2.30
4	I do not believe that in the final analysis there is a distinct difference between right and wrong.	2.21
47	It really bothers me when a person shows up late for an appointment without an explanation.	2.20
50	Before going out, I always check my appearance to make sure I look right.	2.17
30	A group meeting functions best with a definite agenda.	2.14
51	I am tolerant of ambiguous situations.	2.14
9	It irks me to have people avoid the answer to my question by asking another question.	2.05
8	I tend to be very frank with people.	2.03

Item 4 addressed the degree to which an individual categorizes things rigidly as right or wrong without allowing for any so-called "gray area." The officers' responses to this indicated that they tend to allow for no "gray area" issues. This is not surprising, due to the class regarding leadership, ethics, and the code of conduct of the military profession that they had taken shortly before this study was conducted. Items 8, 9, and 10 addressed issues regarding speaking up, telling the truth, and demonstrating candor. These themes were also addressed in a recent class that highlighted instances where units had failed or suffered unnecessary casualties partially because of the failure of subordinate officers to speak up and be candid with their bosses. Items

47 and 50 dealt with punctuality and personal appearance respectively; both are issues strongly emphasized in the military profession.

Thus, it appears possible that the professional military culture in which the participants had been immersed for an average of over 14 years, and the specific recent classes that they had taken, both shaped the officers' AT levels regarding these specific items. This leads to the recommendation for future research for an experimental study to test the stability of AT levels of officers by assessing the AT levels of a randomized sample of officers. In the recommended study, a treatment group would take a course designed to emphasize a particular standard or behavior while a control group would not take the course. If classes or other treatments were found to affect AT levels significantly, additional studies could be designed to determine the duration of the effect. Studies of this sort would provide greater insight into the stability of AT, and could enable the military leadership to alter the behavior of their officers by tailoring curriculum to facilitate the development and reinforcement of specific desired states.

Tolerance of Ambiguity Interaction

It appeared that AT was interacting with one or more additional variables and the combined effect influenced the officers' levels of creativity. This potentiality would reinforce Amabile's confluence model of creativity, as well as build upon Simonton's (1975) research that found a significant three-way interaction between individuals' problem-solving mode (i.e., intuitive vs. analytical), the complexity of the task involved, and the individuals' levels of creativity. As Budner (1962), who developed one of the first pencil and paper tests of AT, said,

> It should also be remembered that in most situations, any personality characteristic is only one of many factors determining behavior. For example, fear of entering upon a novel situation may be more than offset by a greater fear of the opinions of others. (p. 32)

The researcher for the present study deliberately did not inform the officers that their products would be evaluated for their levels of creativity prior to the study. This was done for two reasons. First, Gardner (1988) found that individuals specifically instructed to be creative actually tended to actually make products that were *less* creative. Second, the researcher wanted the participants to develop and submit the plans they thought best.

The SAMS faculty was also using these plans as a means by which the officers would be professionally evaluated and counseled by their seminar leaders. Therefore, the subjective criteria of what would make one plan better than another in the eyes of each of the seven seminar leaders, the degrees to which they had each communicated and stressed these criteria to their respective seminars, and the degree to which the individual students each shaped their plans in order to conform to their seminar leader's expectations were all variables that were unaccounted for in this study, as well as potential sources of interaction with AT in the influence of creativity.

In fact, as Figure 11 shows, the mean creativity scores for the officers in seminar C were considerably lower than the sample mean, and lower than those of officers in seminar B by a statistically significant degree. Although seminars at SAMS were numbered 1-7, they were randomly assigned a letter designation in this research to ensure all participants remained anonymous.

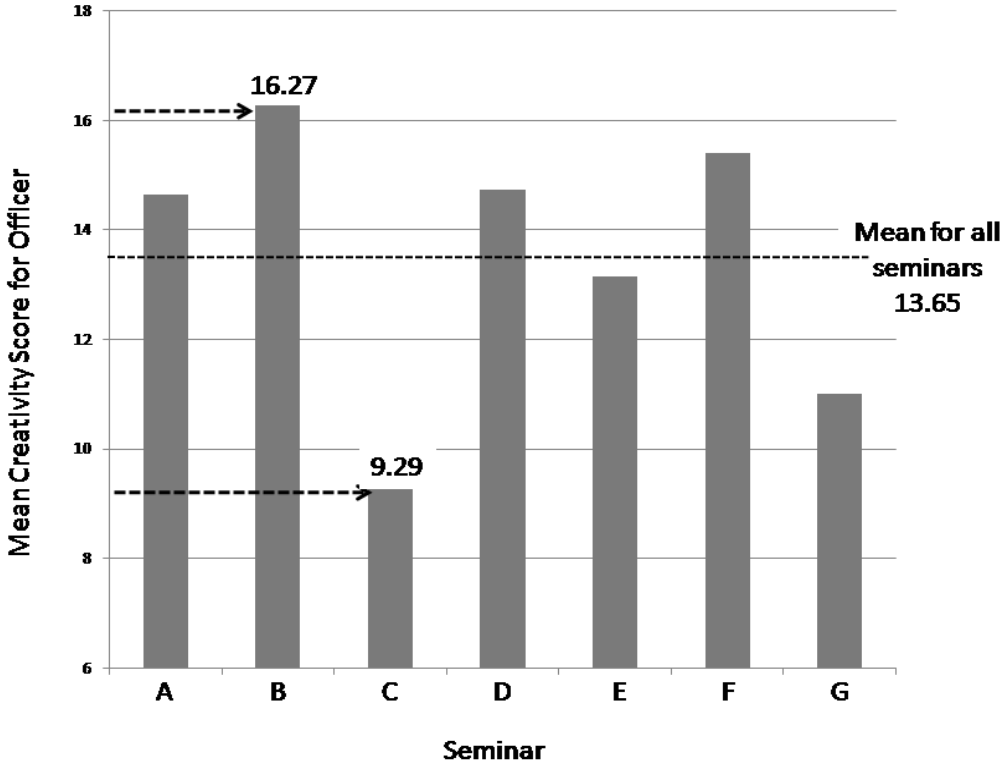

Figure 11. Officers' mean creativity scores by seminar.
Officers' mean creativity scores by seminar. Maximum possible score was 25, minimum possible score was 5.

A post hoc pairwise comparison revealed the differences in the creativity scores by seminar were significant. Due to a lack of homogeneity of variance, $F(6, 59) = 3.41$, $p < .01$, and the fact that the seminars had different numbers of officers participating in the study, a Welch test was performed to determine the omnibus, $F(6, 21.42) = 6.176$, $p < .01$, which showed a statistically significant difference in at least two of the seminars' creativity scores. A Tukey HSD pairwise comparison revealed the differences between the creativity scores of seminars B and C were significant ($p < 0.05$).

To gain a better understanding of what happened, an analysis of the correlations between AT and creativity was conducted separately for the officers in seminars B and C. As seen in

Table 16, in seminar B, where the officers had the highest average creativity scores in the class, there was a small positive correlation between their levels of AT and creativity. In contrast, for the officers in seminar C, who had the lowest average creativity scores in the class, there was a medium negative correlation between their levels of AT and creativity. This illustrates that in seminar B, officers with higher levels of AT were *more* creative, but in seminar C, officers with higher levels of AT were significantly *less* creative. Clearly some other variable interacted with AT in its relationship with creativity.

Table 16.
Pearson r between AT and Creativity for Seminars B and C

Seminar	Mean Creativity Score for Seminar	Mean AT Score for Seminar	Pearson Coefficient for AT - Creativity Correlation
B	16.27	157.91	0.136
C	9.29	150.29	-0.386
All 7	13.65	154.15	-.099

The differences between the two seminars might include differences in the personal characteristics or abilities of the students; differences in the characteristics, abilities, or leadership and teaching styles of the seminar leaders; or some combination of both. This study was unable to determine what factor or factors contributed to the differences in creativity of the officers in these two seminars, but can instead only suggest possible explanations and recommend directions for future research.

The researcher examined the student assignment policy at SAMS, specifically, the student demographics of the two seminars. Incoming students are assigned to their seminars at the beginning of the year by administrative officials in such a manner as to ensure the greatest

possible diversity of background, branch of service, gender, and experience level in each seminar. It is possible that as a result of pure chance, the assignment of officers to their seminars at the start of the year resulted in a significantly uneven distribution of individuals who possessed another personality variable, or some combination of personality variables, that strongly interacted with AT to impact creativity levels. It is therefore recommended that an additional study be conducted in which all of the officers are administered a battery of instruments to enable the assessment of a more thorough set of personality variables. This would allow a more robust correlational assessment, which could produce a better understanding of which personality variables combine, and in what way, to optimize the officers' creative achievements.

However, the study should not be limited to a focus solely on the students. Wenglinski (2002) found that classroom teachers have significant impact upon the attitudes of their students, and Torrance (1988) determined that the students of highly creative teachers go on to demonstrate more creative achievement than the students of less creative teachers. In the case of SAMS, where the seminar leaders are hand-picked officers with recent command experience who serve as professional role models and mentors for the students, the impact might be much greater than in the normal educational setting. The seminar leader of the seminar with the very low creativity scores, previous to this assignment, had served as a member of the team of officers whose job was to visit the various staffs in the Army operational forces, provide instruction on Army operational and planning doctrine, and then evaluate the members of that staff on the degree to which they adhered to established doctrine during a military exercise. Although purely anecdotal, the situation was suggestive of a potential relationship between an instructor whose previous job had been to teach and evaluate individuals on their adherence to convention, and his

students, whose independently developed military plans were rated much lower in creativity than the those of the officers in the other six seminars.

Somech (2006) found the leadership style practiced by the team leader significantly affected the creativity of functionally heterogeneous teams. The possibility that the seminar leader's character, expectations, guidance, or style significantly influenced the creativity levels of his officers led to the next recommendation for future research: to conduct a study to explore the impact of leadership style of SAMS instructors upon the levels of creativity of the officers in their seminars. An additional reason for this study's results might have to do with the task itself.

Planning as Complex Activity

According to the Army manual covering planning and the development of orders, "Planning is the means by which the commander envisions a desired outcome, lays out effective ways of achieving it, and communicates to his subordinates his vision, intent, and decisions, focusing on the results he expects to achieve" (Department of the Army, 2005, p. 1-2). To guide officers in planning, Army doctrine has established the military decision-making process containing the following sequential steps.

1. Receipt of mission: In this step, the commander of the unit receives an order from his higher headquarters assigning him a new mission, or during on-going operations, he perceives a change in the disposition of his forces or the enemy forces or other battlefield factors that provide him the opportunity to accomplish his assigned mission better by changing his current concept of operations (Department of the Army, 2005). In the present study, the officers were all issued their guidance and scenario documents together.

2. Mission analysis: In this step, the commander and staff analyze the orders and reports from their higher headquarters, as well as all information available to them regarding the enemy and the operational environment (Department of the Army, 2005). The result of this step is that the commander identifies his unit's mission, that is, what exactly they have to achieve.
3. Course of action (COA) development: In this step, the commander and staff develop potential ways in which their unit could accomplish their designated mission with the resources available. Doctrine specifies that planners will develop for each COA a written description and a graphical depiction, called the COA statement and COA sketch, respectively (Department of the Army, 2005). In the present study, the officers each had to submit a COA statement and a COA sketch. Typically, if time permits, the commander has his staff develop multiple COAs for consideration.
4. COA analysis (WARGAME): In this step, the commander and staff conduct an analysis of the COA to examine it in further detail and visualize how it would work against various enemy actions (Department of the Army, 2005).
5. COA comparison: In this step, the commander and staff compare the different COAs to identify the one that would accomplish the mission most effectively (Department of the Army, 2005).
6. COA approval: In this step, the commander selects the COA for execution and directs the staff to develop the appropriate orders (Department of the Army, 2005).

For the present study, the officers were told neither how many COAs they were to develop nor which planning process they were to use. They were directed only to submit the COA statement and sketch for their best plan, with the additional details left to their judgment. Whatever process they utilized to develop their plans, the officers had to perform a wide range of cognitive functions.

They first had to assess their current situation. Because this was an exercise, the officers had to analyze the situation presented to them in the form of many pages of reports, maps, and notional analyses performed by other notional military staffs. They had to comprehend and make sense of a large number of facts regarding such things as the forces available to them, the disposition of the known enemy forces expected to be opposing them in their efforts, the terrain and infrastructure in their area of operation, and the anticipated weather patterns. By design, the information presented to the officers was partial, in that many relevant details were omitted. Additionally, some of the analyses and interpretations presented to them in the form of reports from the staffs other military units were in some ways contradictory. The officers were thus forced, as Bruner (1973) described, to go beyond the information given.

Officers had to assess how each of these pieces of information related to and influenced the others. They had to anticipate not only what the enemy might try to do and how they might try to do it, but also what the enemy might expect them to do. As the officers went through this complex cognitive task, which included analysis and synthesis, they presumably drew upon their existing knowledge base formed through personal experience and academic study. Officers sought to form a model to apply that would simplify the problem facing them while remaining an adequate representation of the real situation (Klein, Moon, & Hoffman, 2006). The step ends

with the officers having determined both the current situation and what they want it to be in the future.

Having assessed the current situation and developed an understanding of the complexities of the problem, however accurate or inaccurate, the officers must then determine how best to employ their available resources in time and space to solve the problem and accomplish their mission. As the officers completed the steps of this complex cognitive activity, they drew upon various cognitive skills (Lesgold, 1988). It seems possible that high levels of AT might have different impacts on the overall planning function at different phases. For example, during the mission analysis step, in which the officers frame the problem, lower levels of AT might drive the officers to conduct a more thorough study and analysis of all of the available information. More analysis and study of available information would presumably increase the officers' domain-relevant knowledge, and creativity has been found positively correlated with domain-relevant knowledge levels (Mayer, 2006; Rietzschel et al., 2007; Wynder, 2007).

However, it seems equally plausible that lower levels of AT during the COA development step might lead officers either to rigidly adhere to the doctrinal uses for the various forces available or to seek premature closure, selecting the first COA imagined and failing to explore other possibilities. Milgram and Rabkin (1980) found that when individuals seek multiple possible solutions to a given problem, their most original ideas tend to be developed later in their thought sequences. Therefore, it seems possible that lower levels of AT might lead officers to adopt the first idea they thought of and therefore prevent the generation of highly creative COAs during the COA development step. It is therefore recommended that additional research be conducted to assess the specific impact of officers AT levels on their performance of the various cognitive functions at each step of the planning process.

Implications

This research has a few important implications. The results of this study indicate the relationship between AT and creativity in the domain of military planning is not a simple positive correlation. Norton's MAT-50 would therefore not be an effective screening tool for identifying highly creative officers in the selections and admissions process at SAMS. Due to the highly ambiguous environment in which military leaders must operate, the military should conduct or sponsor additional research focused on the development of an instrument to measure AT specifically in the domain of military planning and decision-making.

Additionally, the fact that the officers' AT scores differed to a statistically significant degree between the SAMS seminars suggests that the environment in which they are taught has a meaningful influence on their creativity. Because the seminars in question each received the same exact curriculum, but presented by different instructors, it appears likely that some aspect of the instructor's style, behavior, background, or expectations contributed to the enhancement or stifling of the officers' creativity. With the stated mission to produce creative and adaptive problem-solvers, SAMS should aggressively pursue additional research to determine what aspects of the environment in the seminars causes the divergent results.

Finally, the CAT has been found an effective way to assess the creativity of military plans. No other instruments have been developed that are effective at this task. Due to the Army's desire to enhance the creativity levels of its officers, the identification of an instrument with which to assess the creativity of military plans is a significant development. Due to the relatively high labor costs associated with the use of the CAT (each judge must read, comprehend, and evaluate each of the plans), its use may not be feasible in all cases. However, it can remain of importance as an instrument to assist in the assessment of construct validity during

the future development of a less labor-intensive instrument to measure creativity in the domain of military planning and decision-making.

Recommendations for Future Research

The disconfirming results of the present study suggest a number of future research areas that would serve to increase the understanding of creativity and its relationship with tolerance of ambiguity. One potential study is research to determine the components of AT that relate specifically to the domain of military planning and decision-making and to develop a valid and reliable instrument that measures the same. A second potential study is described below.

An additional correlational study of AT and creativity using the same instruments as the present study could be undertaken, with the following modifications. The first refinement would be to use a sample size that would yield a statistical power of 0.99. If no effect were found with a statistical power of 0.99, it could be safely determined that the study is a case of conceptual disconfirmation, and that the theory is in need of modification.

To determine if the order in which the subscales appear on the instrument affects the responses of the participants, the order in which the subscales and the items of the MAT-50 are presented to the participants should be random and varied. Additionally, to ensure that time was not affecting the results, administer the MAT-50 to a control group of participants with no time limit. The time limit remains appropriate for the military planning task, because the conditions in which military planners must perform in the operational Army include significant pressure and time limitations.

Collect data to assess the instructors', mentors', or evaluators' levels of creativity, dogmatism, cognitive rigidity, and attitudes towards creativity. Then conduct correlational analysis to determine any relationships between these attributes and the creativity levels of the

officers under the charge of the instructors. This research should be of mixed method design, using quantitative analysis to determine the "what" and qualitative to determine the "why."

Capture data at various stages in the participants' planning process instead of solely at the end product. This would facilitate analysis to determine the relationships between AT and the various cognitive sub-steps and processes. Such a step would enable the development of a greater understanding of the impact of AT throughout the stages of this complex cognitive task.

Collect data and conduct correlational analysis on other variables that potentially interact with AT to influence the creativity of military planners and decision-makers. Amabile's (1983, 1996) confluence theory of creativity provides a good starting list, including such variables as risk tolerance, cognitive rigidity, task motivation, domain relevant knowledge, working memory capacity, ability to form remote associations, capacity for divergent thinking.

Summary

In their current missions, military commanders face increasingly complex problems. The operational environment in which they must succeed is characterized by change and uncertainty (Clark, 2008; Hagee, Personal communication, January 8, 2008). The enemies opposing U.S. operations have shown themselves both resilient and resourceful. The methods and tactics that work in one area today will likely be less successful in another area tomorrow (Krawchuk, 2008; Pattee, 2008). To be successful on the modern battlefield, military commanders and planners must be able to react effectively in ambiguous situations and produce new solutions to emerging problems (Banach, 2009). They must be creative problem solvers (Banach, 2009).

To increase the creativity levels of their commanders and planners, the Army must first understand which factors enhance and which factors inhibit creativity. The present study contributed to this effort by examining the relationship between tolerance of ambiguity and

creativity. Tolerance of ambiguity has been widely theorized to correlate positively with creativity (Amabile, 1983, 1996; Barron & Harrington, 1981; Cropley, 1999a; MacKinnon, 1978; Piirto, 2004; Rogers, 1959; Sternberg, 1999), but empirical results have been mixed (Pestonjee, et al., 1999; Zenasni, et al., 2008). Additionally, research has shown creativity to be predominantly domain-specific (Baer, 1998), but no previous research into this relationship had been conducted in the domain of military planning and decision-making.

This research consisted of a correlational analysis conducted to identify the hypothesized positive relationship between the levels of tolerance of ambiguity of the officers attending the U.S. Army School of Advanced Military Studies and the creativity of the military plans they develop. Counter to the prevailing theory, this study found a small negative correlation between these two variables. A post hoc test found a statistically significant difference in the creativity scores between the seminars. The correlation between tolerance of ambiguity and creativity also varied by seminar, with a positive correlation between the variables existing in the seminar with the highest average creativity scores, and a negative correlation between them in the seminar with the lowest average creativity scores. This finding was important because it suggested that another variable interacted with tolerance of ambiguity in the determination of creativity, and that the prevailing theory was in need of refinement. The study concluded with recommendations for future research that would build upon this study and advance the understanding of tolerance of ambiguity and creativity in the domain of military planning and decision-making.

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Appendix A - DEMOGRAPHICS OF SAMPLE

Participant	Age	Years in Service	Branch of Service	Regular or Reserve	Gender	Seminar
1	38	16	US Army	Regular	Male	1
2	37	13	US Army	Regular	Male	1
3	35	12	US Army	Regular	Male	5
4	41	17	US Army	Regular	Male	2
5	35	13	US Army	Regular	Male	3
6	35	13	US Army	Regular	Male	5
7	36	15	US Army	Regular	Female	6
8	36	17	Foreign Military	Reserve	Male	1
9	36	14	US Air Force	Reserve	Male	6
10	32	11	Civilian	Reserve	Male	6
11	40	17	US Army	Regular	Male	4
12	36	14	US Army	Regular	Male	2
13	34	13	National Guard	Reserve	Male	6
14	35	13	US Army Reserve	Reserve	Male	7
15	35	13	US Army	Regular	Female	3
16	35	13	US Army	Regular	Male	6
17	36	16	US Army	Regular	Male	4
18	42	25	US Army	Regular	Female	4

19	34	13	US Army	Regular	Male	4
20	35	13	US Army	Regular	Male	3
21	37	14	US Army Reserve	Reserve	Male	7
22	39	16	US Army	Regular	Male	6
23	37	14	US Army Reserve	Reserve	Male	7
24	37	15	US Army	Regular	Female	6
25	32	10	US Army Reserve	Reserve	Female	7
26	43	18	National Guard	Reserve	Male	1
27	43	23	US Marines	Reserve	Male	6
28	36	12	US Army	Regular	Male	4
29	34	12	US Army	Regular	Male	1
30	34	12	US Air Force	Reserve	Male	7
31	36	13	US Army	Regular	Male	4
32	34	12	US Air Force	Reserve	Male	1
33	35	13	US Army Reserve	Reserve	Male	7
34	34	13	US Army	Regular	Male	1
35	33	11	US Army	Regular	Male	1
36	37	14	US Army	Regular	Male	2
37	34	14	US Army	Regular	Male	3
38	35	12	US Army	Regular	Male	2
39	35	12	US Army	Regular	Male	3
40	35	12	US Army Reserve	Reserve	Male	7
41	35	12	US Army	Regular	Male	3

42	40	19	US Army Reserve	Reserve	Male	4
43	40	21	Foreign Military	Reserve	Male	3
44	35	13	US Army Reserve	Reserve	Male	7
45	36	14	US Army	Regular	Male	5
46	41	24	US Navy	Reserve	Male	1
47	40	17	US Army Reserve	Reserve	Male	7
48	34	13	US Army	Regular	Male	3
49	35	11	US Army Reserve	Reserve	Male	7
50	35	12	US Army	Regular	Male	2
51	36	14	US Army	Regular	Male	5
52	39	17	US Army	Regular	Male	3
53	33	12	US Army Reserve	Reserve	Male	7
54	40	15	US Army	Regular	Male	3
55	37	14	US Army	Regular	Male	5
56	35	12	US Army	Regular	Male	6
57	37	18	US Air Force	Reserve	Male	2
58	37	16	US Army	Regular	Male	6
59	36	13	US Army	Regular	Male	3
60	37	14	US Army	Regular	Male	1
61	34	12	US Army Reserve	Reserve	Male	3
62	54	19	US Army	Regular	Male	2

63	34	12	US Army	Regular	Male	6
64	41	15	US Army	Regular	Male	3
65	34	11	US Army	Regular	Male	3
66	35	13	US Army	Regular	Male	1

Appendix B - NORTON'S MEASUREMENT OF AMBIGUITY TOLERANCE (MAT-50)

Item	Subscale	Item
1	Philosophy	Almost every problem has a solution
2*	Philosophy	I like to fool around with new ideas, even if they are a total waste of time
3	Philosophy	Nothing gets accomplished in this world unless you stick to some basic rules
4*	Philosophy	I do not believe that in the final analysis there is a distinct difference between right and wrong
5	Philosophy	Usually, the more clearly defined rules a society has, the better off it is
6	Philosophy	Personally, I tend to think that there is a right way and a wrong way to do almost everything
7	Philosophy	I prefer the certainty of always being in control of myself
8	Interpersonal Communication	I tend to be very frank with people
9	Interpersonal Communication	It irks me to have people avoid the answer to my question by asking another question
10	Interpersonal Communication	I really dislike it when a person does not give straight answers about himself.
11	Interpersonal Communication	It really disturbs me when I am unable to follow another person's train of thought
12	Interpersonal Communication	I prefer telling people what I think of them even if it hurts them, rather than keeping it to myself.
13	Public Image	It would bother me if different close friends of mine had conflicting opinions of me

14	Public Image	I always want to know what people are laughing at
15	Public Image	It intensely disturbs me when I am uncertain of how my actions affect others
16	Public Image	It bothers me when I don't know how strangers react to me.
17	Job Related	I function very poorly whenever there is a serious lack of communication in a job situation
18	Job Related	In a situation in which other people evaluate me, I feel a great need for clear and explicit evaluations
19	Job Related	If I am uncertain about the responsibilities of a job, I get very anxious
20	Job Related	If I were a scientist, I might become frustrated because my work would never be completed (science will always make new discoveries.)
21*	Job Related	If I were a doctor, I would prefer the uncertainties of a psychiatrist to the clear and definite work of someone like a surgeon or X-ray specialist
22	Problem Solving	Once I start a task, I don't like to start another task until i finish the first one
23	Problem Solving	Before any important job, I must know how long it will take
24	Problem Solving	In a problem-solving group it is always best to systematically attack the problem
25	Problem Solving	A problem has little attraction for me if I don't think it has a solution
26	Problem Solving	I do not like to get started in group projects unless i feel assured that the project will be successful
27	Problem Solving	In a decision-making situation in which there is not enough information to process the problem, I feel very uncomfortable.
28	Problem Solving	I don't like to work on a problem unless there is a possibility of coming out with a clear-cut and unambiguous answer
29	Problem Solving	Complex problems appeal to me only if I have a clear idea of the total scope of the problem
30	Problem Solving	A group meeting functions best with a definite agenda

31	Social	I seem to enjoy parties the most when I know most of the people there
32	Social	Before going to a party, I always want to know what kind of a party it is
33	Social	I get pretty anxious when I am in a social situation involving me which I have little control of
34	Social	Whenever I am in a new group, I usually take the initiative in introducing myself
35	Social	First impressions tend to be very important to me
36	Social	Whenever I go out to have fun, I like to have at least a vague purpose in mind
37	Social	I am just a little uncomfortable with people unless i feel that i can understand their behavior
38	Social	I don't feel comfortable with people until I can find out something about them
39	Social	I have a good idea of exactly how many friends I could really count on
40	Habit	I like to know ahead of time what will be for dinner
41	Habit	Whenever I go on a long trip, I like to keep track of the miles to go
42	Habit	I will not consider buying an item unless the price is clearly marked on it
43	Habit	It matters to me to know what day it is
44	Habit	I get very anxious waiting to hear the election results
45	Habit	I usually like to know what time it is
46	Habit	I want to know what a salesman is selling before I'll listen to him
47	Habit	It really bothers me when a person shows up late for an appointment without an explanation
48	Habit	If I don't get the punch line of a joke, I don't feel right until I understand it
49	Habit	I enjoy carefully rehashing my conversations in my mind afterwards
50	Habit	Before going out, I always check my appearance to make sure I look right
51*	Habit	I am tolerant of ambiguous situations
52	Habit	The best part of working on a jigsaw puzzle is putting in that last piece

53	Art Forms	I tend to like obscure or hidden symbolism
54	Art Forms	Mysticism is too abstract and undefined for me to take seriously
55	Art Forms	If I miss the beginning of a good movie, I like to stay to see the start of it
56*	Art Forms	Vague and impressionistic pictures appeal to me more than realistic pictures
57	Art Forms	I tend to prefer pictures with perfect balance in the composition
58*	Art Forms	I like movies or stories with definite endings
59	Art Forms	Generally, the more meanings a poem has the better I like it
60	Art Forms	A poem should never contain contradictions
61	Art Forms	In the final analysis, the correct interpretation of a poem is the author's interpretation

Note. *items must be reversed in the scoring.

Appendix C - CREATIVITY AND TOLERANCE OF AMBIGUITY SCORES

Participant	AT[a]	Creativity[b]	Creativity Scores by Judge				
			J1	J2	J3	J4	J5
1	200	18	4	3	3	4	4
2	196	20	4	5	5	2	4
3	185	13	3	4	2	3	1
4	184	9	2	1	1	3	2
5	182	15	5	3	4	2	1
6	182	10	4	2	2	1	1
7	181	9	1	3	1	3	1
8	180	11	2	3	3	2	1
9	175	16	1	4	4	4	3
10	174	6	1	2	1	1	1
11	173	8	1	2	1	3	1
12	172	7	1	1	1	1	3
13	172	17	3	4	4	3	3
14	171	10	2	2	3	2	1
15	170	16	5	3	2	3	3
16	169	8	1	1	2	3	1
17	168	19	5	4	4	3	3
18	167	13	1	2	3	3	4
19	167	19	3	4	3	5	4
20	166	14	3	4	3	2	2
21	166	17	3	4	3	3	4
22	166	16	5	2	4	3	2
23	165	8	1	3	1	2	1
24	165	17	4	4	4	3	2
25	164	8	1	3	1	1	2
26	164	18	4	4	4	2	4
27	161	22	5	4	5	4	4
28	160	16	3	2	3	4	4
29	160	17	4	5	4	2	2
30	159	10	2	4	1	2	1
31	159	7	1	1	1	2	2
32	158	12	1	2	2	4	3

33	157	22	5	5	4	4	4
34	152	20	4	4	4	4	4
35	151	15	4	3	3	2	3
36	150	8	2	2	1	1	2
37	150	14	2	4	2	2	4
38	148	10	3	3	1	1	2
39	148	13	1	4	1	3	4
40	148	10	3	2	2	2	1
41	147	18	5	3	3	4	3
42	145	10	2	1	2	2	3
43	144	10	2	2	2	3	1
44	144	7	1	2	1	1	2
45	143	22	3	5	5	4	5
46	143	14	3	3	2	3	3
47	143	8	2	2	1	1	2
48	143	18	5	4	3	2	4
49	142	6	1	1	1	2	1
50	140	13	2	2	3	3	3
51	140	22	5	4	4	5	4
52	140	16	3	4	1	4	4
53	138	15	1	3	3	4	4
54	136	15	4	4	3	3	1
55	135	10	1	2	3	2	2
56	134	19	4	4	4	4	3
57	134	8	1	2	1	3	1
58	128	10	2	2	2	2	2
59	128	13	2	4	3	1	3
60	124	21	5	4	4	4	4
61	124	11	2	2	2	2	3
62	124	10	2	2	2	2	2
63	123	22	4	4	5	5	4
64	120	12	2	2	2	4	2
65	118	20	5	3	4	4	4
66	109	13	3	4	2	3	1

[a] Tolerance of ambiguity scores from shortened version of Norton's (1975) MAT-50.
[b] Creativity score is total of scores given by 5 judges using Amabile's (1996) CAT.