Divergent Thinking and Giftedness in Children

Shagun Sheena Sachdev

A Dissertation Submitted to the Faculty of
The Chicago School of Professional Psychology
In Partial Fulfillment of the Requirements
For the Degree of Doctor of Clinical Psychology

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Dedication

This dissertation is dedicated to my mother, father, and husband Jon. Without their love and support, this journey would not have been so gentle. I also want to dedicate this dissertation to children discovering their special abilities, getting lost in their worlds, and never giving up on their quest for curiosity.

Acknowledgements

Many people have been involved in the research, development, and final product of my dissertation. I would like to thank Dr. Balice for our weekly sessions. Those coffee breaks helped me better understand the meaning behind my work. The endless hours we spent working on statistics was rewarding. I would also like to thank Dr. Harris, for taking an important, supporting role in my work. Your inquisitive nature has helped me further investigate other facets of my work.

Most of all, I would like to thank my loving parents and husband. Mom and Dad, I could not have asked for more giving and encouraging parents. Since I was a child, it has been your dream for me to be a doctor. I hope to always make you proud. Thank you for your undying loyalty. My husband Jon, since you have been with me, you have been with my dissertation. Your abundant jokes and silly humor have lightened the load on me during troubling times. I am enthusiastic to see the next chapters in our life together. And to my dog Baxter, thank you for cuddling me when times got rough.

Abstract

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The purpose of this study was to investigate the relationship of creativity and intelligence. The current study was interested in testing gifted children's divergent thinking. For the purposes of this study, creativity was defined as the cognitive process of divergent thinking, the ability to generate as many possible solutions to a problem. Thirty-four children (ages 11 to 13) were tested in an afterschool program on the Alternative Uses Test (AUT), which asks the child to think of all of the uses for common, ordinary objects. The children were deemed gifted according to their California Standards Test (CST) scores in English and Math (350 or higher). The results of this study found that that gifted children had higher scores on the AUT, than their nongifted peers, thereby rejecting the threshold theory. Although there was a relationship between giftedness and divergent thinking, future research should focus on IQ testing and creativity test batteries.

Table of Contents

List of Tables

List of Figures

Chapter 1: Nature of Study

"The mere formulation of a problem is far more often essential than its solution. To raise new questions, new possibilities, to regard old problems from a new angle requires creative imagination and marks real advances." –Einstein

Background of the Problem

A recent article in *Newsweek* (Bronson & Merryman, 2010) declares a "Creativity Crisis." Americans' creativity scores are falling. After analyzing 300,000 Torrance scores of children and adults, Plucker (1999) discovered creativity scores had been steadily rising, until 1990. Since then, scores have moved downwards. The most serious decline has occurred in kindergarten thru sixth grade children. This lack of creativity could be attributed to the fact that children watch television and play video games more often than before—as well as to a lack of nurturing creativity in their lives. Torrance's creativity index predicted that children, whom he tested in 1958, would achieve creative accomplishments as adults. Plucker (1999) reanalyzed Torrance's data, and his lifetime creative accomplishment was over three times stronger for childhood creativity than for childhood IQ. People in the United States are recognizing the importance of divergent thinking—the ability to generate many possible solutions to an open-ended problem. While lack of creativity has been attributed to excessive television, video games, and inattention to nurturing creativity, it is important to consider how America's children will unleash their potential.

In 1999, the UK National Advisory Committee on Creative and Cultural Education (NACCCE) published a report in which they elaborated on the definition of creativity (Villalba, 2008). The committee put forth that creativity includes imagination, purposeful thought, and original ideas—all of which have value. The NACCCE recognizes the potential for creative achievement in all fields of human activity. Creativity can have a spillover effect amongst innovative processes (Villalba, 2008). The NACCCE recognizes the importance of cultivating creativity in order to further a student's efforts in all fields—and yet this matter of importance has been ignored in many school systems, which, due to budget cuts, have eliminated many of their arts and extracurricular activities. If we are teaching our students anything about creativity, it is in vain, inasmuch as high school dropout rates are escalating (Kim, 2008). In 2008, the British secondary school curriculum (from science to foreign language) was revamped in an effort to emphasize the idea generation. The curriculum emphasized Torrance tests, the leading creative testing assessment, in order to evaluate their progress. The European Union (EU) designated 2009 as the "European Year of Creativity"—focusing on innovation, holding conferences on the neuroscience of creativity, financing teacher training, and instituting problem-based learning programs for both children and adults. Similarly, in China the drilling teaching style has been eliminated. They are adopting a problem-based learning program, as well—while the United States has adopted the former Chinese style of teaching. Educators are now focusing on standardized curricula, rote memorization, and nationalized testing. The *No Child Left Behind* program—implemented by Congress, in 2001—requires schools to administer annual standardized

testing in order to assess whether or not they are meeting state education standards (Kim, 2008). Because open-ended questions encourage more creativity, it may be advantageous for students to have such questions in their curricula.

Creativity spans several fields and can be taught in subjects such as history, science and mathematics. Creativity involves combining new information with old information (Guilford, 1959). Practicing creativity makes the network quicker and better. Guilford asked, "Why is there so little apparent correlation between education and creative production?" The development of a creative person is not strongly emphasized under our current system—yet this has not stopped researchers from studying the effects of creativity in the classroom (Amabile, 1996; Renzulli, 1986; Runco, 1993; Sternberg, 2006; Torrance, 1988).

Chapter 2: Review of the Literature

Creativity has long been worthy of a proper definition. The difficulty lies in creating a definition that can encompass the whole experience. Researchers have been unclear as to what makes the process come about, as well as what makes one follow through with the act of creativity. Rhodes (1961) found approximately 50 definitions of creativity that were organized into four categories: person, process, press, and products. Kaufman, Plucker, and Baer (2008) supported this categorization in their definition of creativity as "the interaction among aptitude, process and environment by which an individual or group produces a perceptible product that is both and novel and useful as defined within social context" (p. 90). *Person* refers to various personality traits, such as temperament, attitude and self-concept. *Process* is the cognition (motivation, perception, learning, thinking and communicating) that takes place in order to yield creativity. *Press* refers to the interactions between human beings and their environment, such as those at school or with mentors. *Product* refers to the finished outcome of a creative endeavor, as well as how it will be deemed to be creative by teachers, peers or experts in the field.

For the purpose of this dissertation, *creativity* will be defined as the cognitive process of divergent thinking. That is, creativity will be defined as the ability to generate many possible solutions to a problem. Creativity will be reviewed in a chronological order of events—with evidence from renowned researchers in the field. Creativity has its roots in the field of intelligence.

Intelligence

To understand the importance of creativity, one must first historically look at intelligence. Genetics is predominantly accepted as the vehicle for transfer of intelligence (Snyderman & Rothman, 1988). Just as a child has his father's hair color, or her mother's eyes—the child would also gain the same capacity for knowledge that his or her parents had.

Beginning in 1886, Galton and Cattell were the first to assess intelligence with a battery of mental tests. The tests investigated individual differences in sensory capacities—attempting to find, an explanation for how mental processes were related. Instead of subjective, anecdotal and retrospective speculation characteristic of previous works, Galton and Cattell were the first to search for explanations through quantitative psychometric data. Galton was the first to introduce statistics to the social sciences and coined the term "nature versus nurture." He established psychometrics as a method for the study of individual intellectual differences—especially for the study of superior abilities (Clark, 1992; Grinder, 1985; Snyderman & Rothman, 1988).

After more than one century of research in the field of mental abilities, investigators now know that intelligence may be easier to measure than to understand or define (Snyderman & Rothman, 1988). Spearman began to use correlational techniques to investigate the relationship between various measures of intelligence. He was intrigued by the positive correlations found between grades of students in various school subjects—a discovery that contradicted many previous findings. In 1904, Spearman published a paper presenting techniques for calculating coefficients of correlation (Brody,

1997). Spearman's theory assumes that all measurements of intelligence are related to a common, general intellectual function; and that scores on a measure of intelligence can be separated into two components—a general, or "g" component—and a specific, or "s" component. While the "g" component is determined by that which the measure has in common with all other measures of the common intellectual function, the "s" component is specific to each measure. This implies that the higher the ratio of "g" to "s," between any two measures of intelligence, the higher the correlation. This is known as the two-factor theory of intelligence. Cattell proposed the existence of a hierarchical structure of ability. The "g" factor would be a general, common factor. There is no agreement on what "g" actually means or its utility (Neisser et al., 1996). There is agreement that basing a concept of intelligence on test scores, alone, ignores many important aspects of mental ability (Kaufman, 2010).

Giftedness and IQ

In 1904, The Intelligence Quotient (IQ) test was developed by Binet and Simon consists of a 30-item scale; organized in order of difficulty, and standardized for children (ages 3 through 11) in the Paris public schools (Snyderman & Rothman, 1988). Test scores were not reported in terms of an absolute level of intelligence—but rather by comparison of the mental age of the student (age-equivalent of highest question answered correctly) to his or her chronological age. Binet recognized that "intelligence increases during childhood, and it was more fruitful for a psychology of individual differences to

concentrate on relative levels of intelligence than try to measure such a nebulous concept in absolute terms" (Snyderman & Rothman, 1988, p. 15).

In 1921, Terman started a longitudinal study, sponsored by the U.S. federal government, which had the purpose of studying what gifted children were like throughout their lifespans and what factors influenced their development (Oden, 1968; Schneider, 2000; Terman, 1954). Typical gifted children had diverse interests—with an interest maturity level two or three years above the age norm. The results showed that high potential individuals differed within their groups in many ways; therefore, they did not form a homogenous group. The differences between the least and most successful individual was indicative of the influence of parents' socioeconomic status and college level. Their IQ continued to increase during adulthood. Intelligence, therefore, was determined to result from a mixture of genetics and environment (Sisk, 1987). The results also demonstrated that IQ could be used, from early ages, to predict superior achievement in adults. However, Terman warned that IQ tests could not predict the direction that achievement would take in adults since personality factors or "accidents of fortune will affect the fruition of exceptional ability" (Terman, 1954, p. 224). Terman's longitudinal observation study helped give birth to the gifted-child movement.

Piaget (1961) explored intellectual development as a result of changes in cognitive function. Piaget hypothesized that cognitive processes emerge as a result of the reorganization of psychological structures resulting from the dynamic interaction of the child with his or her environment. The interaction (among the critical variables) to cognitive development—such as maturation, experience, and social interaction—

regulates the direction of the child's development. Piaget tested not what one knows (the *product*) but rather how one knows or thinks (the *process*) as well as how in obtains and uses information to solve problems and acquire knowledge (Weinberg, 1989). Piaget was the first theorist to establish an interactive theory of intelligence that suggested how cognitive development may depend on genetic contributions as well as the quality of the environment in which the child lives (Weinberg, 1989).

An individual's intelligence had been used to determine giftedness. Yet, these measures do not require much creative or divergent production thinking. Terman's definition of a "gifted student" is that of one who is able to score in the top one percent of general intellectual ability; as measured by the Stanford-Binet Intelligence Scale (Fleith, Renzulli, & Westberg, 2002). Although there has been debate about the process of creativity being independent of intelligence, their convergence could be the key to finding a gifted individual. "Gifted" is domain specific (Wallach, 1985). IQ scores are not criteria for giftedness. Considerable work (Brody, 1997) has demonstrated scores on tests of intellective ability are not good predictors of giftedness—yet, they are still used to assess this talent. Walberg (1971) found virtually no correlation between IQ scores and awards or prizes for out-of-school accomplishments in the fields of creative writing, science, music, the visual arts, drama, dance and group leadership.

In 1972, Marland (the U.S. Commissioner of Education) indicated six domains in which giftedness could occur: intellectual functioning, specific academic abilities, creativity, leadership, visual and performing arts, and psychomotor ability—as noted by specialists. Over the years, there have been at least seventeen more definitions of

giftedness in research literature (Brody, 1997). All of them indicate some performance or achievement products that can be evaluated as valuable to society. Much like creativity, the product of one's talents is evaluated and deemed gifted, talented, or creative. Gifted and talented education (GATE) is a broad term applied to specialized programs for gifted students in public schools. The federal government does not fund or mandate these programs. These types of programs are available in only 29 states (Brody, 1997). To earn a place in a GATE program, one must have high IQ scores (as measured by a standardized test) or have high scores in academic subject areas. These stipulations are common, but other requirements include teacher recommendations and excelling in one or more fields as "creative." Previous achievement in a domain is considered the best single predictor of achievement in any academic domain. Along with IQ as a strong predictor of achievement across all domains, the GATE identification procedure attains high predictive validity for future success (Brody, 1997).

Recent theorists, such as Renzulli, Gardner, and Sternberg, have had a multifaceted approach to giftedness). Renzulli (1978) defined giftedness as containing three components: above average ability, task commitment, and creativity. Above average ability includes: high levels of abstract thought, specific area knowledge, and adaptability to novel situations. Task commitment includes: determination, motivation, and self-confidence. Gardner (1983) is known for his theory of multiple intelligences, which conceptualizes intelligence in a different approach, offering opportunities beyond academic success (such as dancing, video games, and social interactions). Creativity includes: fluency, flexibility, originality of thought, and curiosity. Sternberg (1985) is

renowned for his triarchic theory of intelligence—comprising incorporated analytical, creative, and practical intelligence. Creativity seems to be involved in each theorists work with intelligence—yet, traditional testing does not embrace creativity.

The "threshold of intelligence," in relationship between creative thinking abilities and academic achievement, was an important finding by Getzels and Jackson (1961, 1962). They found that one's creativity increased as one's IQ increased, but after a 120 IQ, creativity started to decline. Yamatmoto (1964) was interested in the same concept and tested creative abilities (using the Torrance Test of Creativity) and academic achievement (using the Lorge-Thorndike Intelligence Test.) He found that within the top 20 percent of those identified by creative thinking, the threshold theory was noted in individuals whose IQs were between 120 and 135. In a longitudinal study by Torrance and Wu (1981), adults who were identified when they were children as either "creatively gifted" or as "intellectually gifted" were investigated for lifetime achievements. They were assessed by: high school achievements, post high school achievements, creative style of achievements, quality of the highest creative achievements, and creativeness of a future career image. The adults who were identified as "creatively gifted" (but not "intellectually gifted") equaled or surpassed those who were identified as "intellectually gifted" but not "creatively gifted."

Anastasia and Schaefer (1971) found AUT correlated .21 with grade-point average and .27 with IQ (as cited in Guilford, Christensen, Merrified, & Wilson, 1978). Alker, Carlson, and Hermann (1969) found that the AUT was not significantly correlated to the SAT verbal scores of 108 male college students (as cited in Guilford et al., 1978).

Bowers (1960) administered the AUT to 150 children in elementary school and found that it correlated only .26 with the Stanford-Binet IQ (as cited in Guilford et al., 1978). Steinberg, Dahlberg, and Iscoe (1963) found that the flexibility score of 96 nine-year-olds correlated .33 with IQ (as cited in Guilford et al., 1978). Yong (1994) studied the relation between creativity and intelligence on students in Malaysia, using the Torrance Test of Creative Thinking and the Cattell Culture Fair Intelligence Test. Yong found that the "creative students" were more intelligent than the "non-creative" ones. From these past research studies, the typical correlations between the AUT and IQ lie in the region of .2 to .3 (Guilford & Christensen, 1974). A high score in AUT (divergent production) indicates a high IQ, but a high IQ does not necessarily indicate a high status in divergent production (Guilford & Christensen, 1974). Although, results of the "relationship of intelligence" and "creativity" have been inconclusive, it is clear that "creativity" is an important and overlooked component to one's intelligence.

J.P. Guilford: The Beginning of Creativity

In 1950, J.P. Guilford delivered a renowned farewell address pleading with psychologists to focus their efforts on creativity. In a psychological climate wherein behaviorism was the norm, his colleagues and spectators were shocked to hear about creativity from a man who had excelled in psychometrics and factor analysis. Russia had launched the Sputnik satellite and, with it, the hunt for talented, gifted, and creative individuals began in the U.S. The hunt was on for talent and, soon, "creativity" started to create momentum amongst researchers.

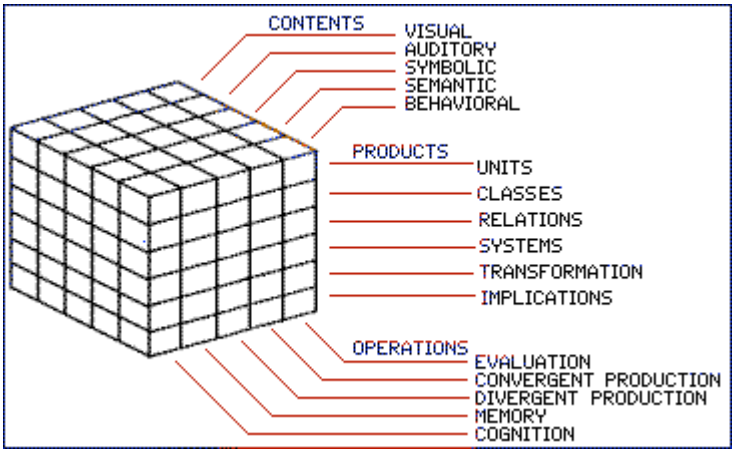
Guilford refuted the common belief that genius is attributed only to intelligence. He challenged the assumption that intelligence had no correlation to creativity. Guilford (1979) thought that IQ was relevant to creativity, but that creativity was too difficult to measure, since it covers such a vast area of intellectual processes. He believed that "creativity" and "creative productivity" extend well beyond the domain of intelligence. He believed that creativity had motivational and temperamental traits. He believed that aspects of one's personality were relevant to creativity, but he focused heavily on the intellectual components. A creative pattern is displayed in creative behavior—which includes such activities as: invention; designing; contriving; composing; and planning. Although the "creative product" is a combination of one's personality and intellect, the "cognitive process in creativity" consumed the brunt of his work.

The Structure-of-Intellect (SOI) Model

It was Guilford who was the first to differentiate "intelligence" from "creativity." It is not that creativity does not take intelligence—rather, that there is no special mechanism of intelligence that will lead to creativity. Also, just because one is "creative," it does not qualify them as "highly intelligent" (in terms of objective testing.) Guilford felt that creativity extended well beyond the domain of intelligence. Guilford challenged older notions of "creativity power" set forth by his predecessors in creativity analysis. Spearman (1927) defended that there was no such things as "creativity power"—rather, it was attributed to special "imaginative" or "inventive" operations which could be resolved into a correlated education (Strernberg, Kaufman, & Pretz,

2002). Guilford states that objective testing and scoring direct us away from the attempt to measure some of the best qualities on an individual. The weak correlation between scores on creativity and intelligence tests—and the relative independence of those two constructs—proposes a multidimensional view of intelligence. "We must look well beyond the boundaries of the IQ if we are to fathom the domain of creativity" (Guilford, 1950, p. 448). Guilford initiated discussions about the role of distinctive cognitive abilities (divergent production), which was not assessed in traditional tests of intelligence.

Figure 1: Structure of Intellect (SOI) Model



Guilford felt the need to develop a system for classifying the many mental abilities that had been and were continuing to be discovered. The first version of his Structure of Intellect (SOI) model was presented in Paris (1955) to an international conference on factor analysis. The SOI model became the main focus of Guilford's research and writing. Like a periodic table, the model suggests where new abilities might be discovered. The number of possible abilities represented by the model has increased over the years; and, in the latest version, there are 180 (Guilford, 1979).

As the SOI model developed, Guilford became more and more interested in applying it to improve education. Despite the widespread popularity of the IQ, Guilford never believed in the Spearman g-factor theory of intelligence, which implied that the IQ is based on a single great ability trait. Furthermore, anticipating much recent controversy about the IQ concept, he doubted the immutability of mental ability. Guilford believed that human abilities are differentiated into increasingly complex systems as a function of more and more education. Guilford believed that children could be trained to be smarter. "Intelligence Education is Intelligent Education" became his motto. "Some Changes in the Structure-of-Intellect Model" Guilford (1988) described intelligence as being a systematic collection of a large number of abilities for processing different kinds of information in various ways. There are six kinds of operations: cognition, memory recording, memory retention, convergent production, divergent production, and evaluation—five kinds of contents: visual, auditory, symbolic, semantic, and behavioral—and six kinds of products: units, classes, relations, systems, transformations, and implications. The SOI model resembles a cube with: contents, products, and operations—each occupying one side. Each ability is defined by a conjunction of the three categories—occupying one cell in the three-dimensional figure. Many of these abilities are correlated with each other. This 6 x 5 x 6 figure yields a total of 180 possible unique abilities—over 100 of which have been empirically verified. Several standardized test for measuring creativity were developed based on Guilford's "structure of intellect" (Guilford, 1988).

Guilford (1979) defined intelligence as "a systematic collection of abilities or functions to process different kinds of information in different forms, with respect to the content (substance) and the product (mental construct)." (p. 475). In his Structure of Intellect (SOI) model of intelligence, Guilford (1950, 1979) suggests at least eight abilities that underlie creativity: fluency, flexibility, novelty, complexity, sensitivity to problems, and evaluation. These abilities are categorized as "divergent thinking" (which involves the capacity to invent new responses), as opposed to "convergent thinking" (which focuses on the ability to reproduce learned content with one right answer.)

Guilford used factorial validity (a form of construct validity)—determined by factor analysis of test answers and criterion validity—to produce the SOI battery of intellect. Guilford believed in a combination of "personality" and "process" to allow creativity. He proposed that a domain of investigation would be: memory visual perceptual abilities, reasoning abilities, and the domain of introversion-extraversion. Guilford hypothesized that one must take into account: sensitivity to problems, ideational fluency, flexibility of set, ideational novelty, synthesizing, ability, analyzing ability, reorganizing, span of ideational structure, and evaluating. Guilford (1950) maintained that "[a] creative personality is one that stresses uniqueness and shuns conformity" (p. 448). His hypothesis rests on skill sets, personality traits and cognitive abilities.

Guilford suggested that creative measurements would show considerable error variance due to function fluctuations and that reliability of tests of creative abilities and of creative criterion will probably be low. Although Guilford wanted an objective measurement of creative thinking, he knew that subjectivity could always influence the

results. Instructions given at the beginning of a test (and other variables) could corrupt the objectivity of measuring creativity.

The Four P's of Creativity

Virtually all researchers had their own theory as to what makes a creative person. While Guilford (1950) and Sternberg (2006) supported "personality factors" and "cognitive abilities," others supported "environment" (Urban & Jellen, 1996) or placed importance on "evaluation" (Halpern, 1996). Many combined the "person," "process," "press" and "products" (Kaufman, Plucker, & Baer, 2008). Feldman, Csizkszentmihalyi, and Gardner (1994) point out that creativity can be approached from several perspectives, each one bringing the possibility of new insights into the nature of creativity—from the person carrying out the work, from the product that rises from the efforts of the person, from the process that brings about the novel idea or product, or from the response of others to the existence of new product.

After Guilford, it was Sternberg who put forth a great effort to understand creativity from a process orientation. Sternberg was quick to follow his predecessors in recognizing the elements of creativity. He thought Guilford and Torrance were both broad thinkers and that they concentrated on divergent thinking as the basis of creativity. He believed in the Investment Theory of Creativity, which entails pursuing ideas that are unknown or out of favor but that have growth potential. A creator must be decisive about his or her products and be able to buy low, sell high. There is a certain amount of risk involved in creativity, and it is up to the creator to be able to sell his ideas to his profit.

Sternberg established three elements to intellectual skills in creativity: synthetic skills, analytic skills, and practical skills. With "synthetic skills," once can see problems in a new way and escape the boundaries of conventional thinking. With "analytic skills," one can recognize which of one's ideas are worth pursuing and which are not. With "practical-contextual skills," one can know how to persuade others—to sell other people on the value of one's ideas. He believes that knowledge can help or hinder creativity. That is, if an "expert makes more and deeper use of an existing structure and hence has to reformulate their thinking more than novices do when there is a deep structural change in the rules of the game; thus one needs to decide to use one's past knowledge" (Sternberg, 2006, p. 89). In other words, an expert may know a subject so well that he may not be able to see outside the box, but a skill set would be necessary for him to be able create. Creativity also involves: one's thinking styles, how one decides to deploy his or her skills in a legislative style, one's personality, and a willingness to "overcome, take sensible risks and tolerate ambiguity" (Sternberg, 2006, p. 89); as well as self-efficacy and motivation—an intrinsic, task-focused motivation that is essential to creativity. If one really loves what they are doing, they will focus on the work rather than the potential rewards (a concept lost amongst our school system). Environmental factors (such as school, parental, and mentor support) are helpful in manifesting a welcoming nature of creativity. The role of decision making—the ability to switch between conventional and unconventional modes of thinking—is a useful component to creativity.

Sternberg (2001) argues that creativity should not be considered in isolation from other constructs of human abilities; rather, it is best understood in a societal context.

Creativity questions and proposes new agendas. He defines creativity as, first, involving thinking that aims at producing ideas or products that are relatively novel, and, second, that are in some respect compelling. Second, creativity has some domain-specific and domain-general elements. It needs some specific knowledge—but certain elements of creativity cut across different domains. Third, it should be measurable—at least to some extent. Fourth, it can be developed and promoted. Fifth, "creativity is not highly rewarded in practice as it is supposed to be in theory"(Sternberg, 2006, p. 93) —and, it can be a spiritual process. Tardiff and Sternberg (1988) also wanted to encompass one's personality factors into a classification of three general areas. The first area involves cognitive characteristics, such as: trait, relatively high intelligence, originality, verbal fluency, abilities, and processing styles that creative individual use to approach problems. The second relates to personality and motivational qualities. The third is related to special events during one's development (first born, etc.) They acknowledged that it is difficult to assess all variables.

The first area emphasizes personality traits of an individual. Sternberg (2004) believed that the willingness to overcome obstacles, take risks and tolerate ambiguity were inherent to for creative functioning. The second area emphasizes products of creative thoughts—including solutions to problems, responses on creativity tests, technological inventions and artifacts, novel ideas, paradigms, and styles. The final product must be novel and generalizable—causing irreversible changes in the human environment—and useful to society. The third area (the "process") focuses on the time constraints involved in the creation of a product, the opportunity to nourish the outcomes

produced, the role of the process of evolution on the final product, and the position of insight in the creative process. The fourth area to approach creativity focuses on creative places—domains, fields, and contexts. A field can affect creativity in three major ways: the general contributions and resources available to individuals within the field; the special effects a particular field may have in its domain; and the nature of the creative expressions that result—specific characteristics that either promote or inhibit creativity.

Torrance regards creativity as almost infinite, involving every sense. Creative thinking is "the process of sensing difficulties, problems, gaps in information, missing elements, something askew; making guesses and formulating hypotheses; possibly revising and retesting them, and finally communicating the results" (Torrance, 1988, p. 47).

Halpern (1996) considers someone creative when he or she produces an outcome or a product that is both unusual and appropriate (meaningful or useful); and it is defined by its consequences and not the process that led to the consequence. It is not a single trait that people either have or do not have, but a set of processes occurring in context—involving novelty in at least one of the processes that leads to creative outcomes and ways of identifying the existence of a new problem—defining it, generating and evaluating possible solutions, and judging how uniquely and how well the problem is solved.

Csikszenthimihlyi (1996) views creativity as "any act, idea, or product that changes an existing domain, or that transforms an existing domain into a new one"—adding that, a creative person is "someone whose thoughts or actions change a domain, or

establish a new domain" (p. 28). To have any effect, an idea must be understandable to others, gathered by the experts in the field, and finally included in the cultural domain to which it belongs. He shifted from "What is it?" to "Where is it?"

Creativity is seen as the product of three main forces: *field* (set of social institutions that selects, from the variations produced by individuals, those that are worth conserving); *domain* (cultural field that will preserve and transmit the select new ideas to the subsequent generations); and *individual* (who brings about some change in the field).

Feldman et al. (1994) defines a creative person as someone who "solves problems, fashions products, or poses new questions within a domain in a way that is initially considered to be unusual but is eventually accepted within at least one cultural group" (p. 71). His definition emphasizes problem solving, problem finding, and the creation of products (such as scientific theories or art.) All creative work occurs in one or more domains—in which the achievement of expertise is required before the individual can execute significant creative work. No person, act or product is creative or not. He sees it as *contextualized* (that forms of creativity are a result of the culture in which individuals live) and *distributed* (creativity does not reside exclusively within the brain, but it arises as a function of the human and artifact resources available to the person.)

Amabile (1996) presents two complementary definitions of creativity—*consensual* (that is readily applicable to empirical research) and *conceptual* (which can be used in building a theoretical formulation of the creative process.) People will be most creative when they are intrinsically motivated in their work—demonstrating passionate interest in something, essentially, for its own sake—because it is pleasant, satisfying,

personally challenging, or appealing. The sense of competence—of mastering something—and self-determination—are essential to intrinsic motivation. Urban and Jellen (1996) view creativity as a non-linear, multidimensional, partially simultaneously occurring process—dependent on personality variables (like motivation) as well as on environmental conditions (such as material resources, and social obstacles.) Urban and Jellen's (1996) model emphasizes six elements of creativity that form an interacting, mutually dependent system—divergent thinking and acting, general knowledge, and a thinking base, a specific knowledge base and area specific skills (focusing on task commitment, motivation and motives—and on openness and tolerance of ambiguity.)

Csikszentmihalyi's Systems Model of Creativity presents an interaction between the domain, the field and the person. The *domain* is a skill set. The *field* is a supporter of the person or the creator's abilities—such as a teacher or parent (Kaufman & Beghetto, 2009). He also stated that the major distinguishing characteristic of creative people is the capacity to experience "flow"—the experience of timelessness and oneness with activity. It is the capacity to be absorbed in a skill that one enjoys thoroughly. Amabile (1996) encourages creativity researchers to consider environmental influences. Her Componential Model of Creativity proposes three major components of creativity: skills specific to the task domain, general creativity, and task motivation (which provide a useful way to conceptualize the importance for the social environment.) *Domain relevant skills* include knowledge, technical skills, and specialized talent. *General creativity skills* are personal factors associated with creativity—such as tolerance of ambiguity and self-discipline (Kaufman & Beghetto, 2009). Those who are driven by *intrinsic motivations*

(such as enjoyment and passion) tend to be more creative than those motivated by *external motivations* (such as money, praise, or grades.) *Intrinsic motivation* is key to relinquishing one's efforts toward one's passions. One's environment is an inseparable component to one's passion to create. Having a supporter, especially in a regarded position (such as a mentor), will be beneficial to one's motivation.

Currently, modern takes on creativity have focused on the intellectual aspects of the process. (Kaufman, Plucker, & Baer, 2008, p. 90) states that creativity is the interaction (among aptitude, process, and environment) by which an individual or a group produces a perceptible product that is both novel and useful (as defined within a social context.) Plucker and Runco (1998) suggest that when people engage in creative activity "their thoughts and actions are guided by personal definitions of creativity and beliefs about how to foster and evaluate creativity that may be very different from theories developed by creativity experts" (p. 37). They argue that the death of creativity measurement is due to personal definitions (that can include one's individual culture or environment), which have made investigating the process a problem. What they have found is that creative people seize upon whatever opportunities they have been given. Mastery of *domain of knowledge* or *skillset* leads to diverse thinking or ideational fluency, which then leads to a creative product. Although measuring creativity has been a difficult process, it has not stopped researchers from figuring out the process.

Torrance, the famous creator of the Torrance Tests—the first and current standard of creativity measurements—was inspired by Guilford. He believed in fluency, flexibility, originality, and elaboration; and he used them to create the most widely used

creativity test. He supported the threshold hypothesis, which holds that, in a general sample, there will be a positive correlation between low creativity and intelligence scores—but that a correlation will not be found with higher scores (Kerr & Gagliardi, 2003). IQ tests are still the most widely used procedure for screening and identifying gifted and talented students.

Divergent Thinking

The divergent thinking approach to the study of the creative process is an approach that has the most explicitly developed theoretical base, underlies most creativity tests and has generated the most empirical research (Glover, Ronning, & Reynolds, 1989). The ability to generate multiple, alternative solutions to open-ended problems is a classic theory in creativity. Having its roots in Guilford's SOI model, the theory is still one of the most recognized approaches to assessment in the field of creativity. Guilford used "divergent thinking" interchangeably with "creativity." Although researchers have not universally accepted "divergent thinking" as "creativity," many have understood its importance as a main component in distinguishing creativity (Baer, 1998; Piirto, 1991; Runco & Nemiro, 1994). There has been little addition to the definition of creativity since Guilford coined it in 1950. Although almost synonymous with creativity, it represents an estimate of the potential for creative thought (Plucker, Runco & Lim, 2006). Convergent thinking, in contrast, allows the mind to essentially weed out the appropriate ideas from the solutions produced in the brain. Divergent thinking requires

both processes. Baer (2003) states that both functions are important in selecting the best ideas.

Divergent thinking is evaluated through: *fluency*, *originality*, *flexibility*, and *elaboration*. The generation of answers to an open-ended question must be useful. *Originality* refers to answers only given by 5% of the respondents. Fluency, also known as ideation, is the number of answers, in total, given by the respondent. It is reminiscent of brainstorming, which encourages as many ideas as possible, regardless of their use that will help achieve an original approach to a problem (Osborn, 1963). Wallach and Kogan (1965) indicated that "ideational fluency" is a necessary precursor to "divergent thinking." Allowing the responses to come freely, without judgment, creates a better collection of answers. In 1976, Milgram and Milgram noted the need for "ideational fluency" as a predictor for unusual ideas. They found that the more conventional ideas are generated earlier, the more original ideas are generated later. The need for original ideas would come with time and less constraint. Our minds first go to the most conventional idea—and then, later, challenge us to think of unconventional ideas. Milgram and Arad (1981) hold that the greater the ideational fluency, the better the ability to generate many original solutions to a problem.

Houtz, Denmark, Rosenfield, and Tetenbaum (1980) found (through using older, gifted elementary students as participants in the study) that *ideational fluency* is the "most useful independent of potential creative thinking measures from intelligence" (p. 119). Borland (1986) also supported *ideational fluency* as a "measure of divergent thinking." He asserted that "the production of many types of ideas (*flexibility*) and the

production of unique ideas (*originality*) are strongly related to the ability to produce many ideas" (p. 249). *Flexibility* is the production of new ideas that are categorically different from other ideas. Adding details or fully developed ideas are defined as "elaborate."

Researchers have been observing students in order to seek evidence of creativity in children (as well as any correlation to IQ) since the 1950's. Guilford's initial conception of a large number of, more or less, "independent divergent thinking factors" was supplanted primarily by a focus on "ideational fluency" as a general associative process—a sort of "g" factor underlying virtually all types of creativity. In a study by Wallach (1970) the "high creativity, high intelligence" children were said "to exercise within themselves both control and freedom"—whereas, the "low creativity, high intelligence" children were "addicted to school achievement." From his research, Wallach (1970) concluded that what matters most is the generating of associates. Studies have confirmed that Wallach and Kogan's test battery shows internal consistency and relative independence from measures of intelligence (Wallach, 1970, 1985). Guilford (1950, 1974), Torrance (1974), Wallach and Kogan (1965), and Wallach and Wing (1969) have suggested that the more creative individuals should possess the types of abilities measured by tests of divergent thinking.

Divergent Thinking Assessment

The Guildford Battery consists of ten individual tests measuring different aspects of divergent production: *Names for Stories*—divergent production of semantic unit; *What*

to Do With It—divergent production of semantic classes; *Similar Meanings*—divergent production of semantic relations; *Writing Sentences*—divergent production of semantic systems; *Kinds of People*—divergent production of semantic implications; *Make Something Out of It*—divergent production of figural units; *Different Letter Group*—divergent production of figural classes; *Making Objects*—divergent production of figural units; *Hidden Letters*—divergent production of figural transformations; and *Adding Decoration*—divergent production of figural implications (Guilford, 1950).

Torrance (Kerr & Gagliardi, 2003)—the originator of the best known standardized creativity tests—cautions against the practice of using objective measures, alone, in assessment. The Torrance Test of Creativity (created in 1966) has been translated into 30 languages and has been used in many countries. It consists of two forms of verbal and figural tests, with two parallel tests. Each test measures: *fluency*—number of ideas; *total number of relevant responses, originality*—rarity of ideas; *number of statically infrequent ideas*—0 if common, 1 is valid; *elaboration*—number of added ideas; and *flexibility*—number of categories of the relevant responses. Torrance based it on Guilfords's Structure of Intellect battery, which included some measures of divergent thinking. He did not view creativity as the only criterion for decision making—rather, he considers which multiple talents must be evaluated and which individual differences in culture should be noted. His tests have extensive validity research. The test-retest reliability is moderate to high—.5 to .93 (Treffinger, 1985).

Hypothesis

Several researchers have been attempting to define creativity. Since first being introduced as a concept, in 1950, Guilford (1979) has associated divergent thinking as synonymous with creativity. This theory has been supported by several researchers (Guilford, 1950; Plucker & Runco, 1998; Sternberg, 2006; Urban & Jellen, 1996; Wallach & Kogan, 1965; Urban & Jeller, 1996).

The definition of creativity has been separated into four categories: person, process, press, and products—describing the aspects of an individual's personality that make them more likely to be creative. The process describes the mental abilities that relate to creativity. Press refers to environmental factors—such as schools or influential teachers. Products refer to the critique of a completed, creative product. This paper focuses on process—particularly, divergent thinking. Because education is a relevant topic, it will be of interest to see if divergent thinking is an ability that gifted children possess more so than their non-gifted peers.

Research Question

Are children in a gifted program able to think more divergently than their non-gifted peers?

Children in gifted programs are selected for high IQ, through teacher recommendations and by leadership. Children in this study who are identified as gifted have received a score of 350 or higher on the Math or English section of the California Standards Test (CST) and/or demonstrate high achievement and academic abilities in all

subjects—including math and science. Because the gifted program often emphasizes convergent thinking—the idea that there is only one solution to a problem—it is hypothesized that students in the non-gifted program may be able to produce as many answers (or have the same fluency) as their gifted peers. Students in the gifted program will develop more answers (or have greater fluency) respecting open-ended questions as a result of giftedness; and the non-gifted will produce fewer answers. The open-ended questions are administered by use of the *Alternative Uses Test* (Guilford et al., 1978). The *Alternative Uses Test* (AUT) asks children to think of different ways of using familiar objects—such as a shoe or newspaper. In sum, it is hypothesized that gifted students will provide more answers on the test than their non-gifted peers provide.

Chapter 3: Research Design and Methodology

Participants

Students who were gifted and non-gifted will participate in this experiment. Students who were deemed *gifted* were operationally defined as those students who have a 350 or higher on the Math or English section of the California Standards Test (CST) and/or demonstrate high achievement and academic abilities in all subjects. Students were in sixth and seventh grade—approximately 11–13 years old—and in gifted and non-gifted classes. This age range was selected, due to their ability to think abstractly. According to Piaget's developmental stages (1973), children in the formal operations (11+ years of age) can manipulate idea mentally, without any dependence on concrete manipulation. At this stage a child can think creatively, use abstract reasoning, and imagine the outcome of particular actions. These cognitive abilities are necessary to understand the questions from the *Alternative Uses Test* and give appropriate answers. This age range has also been in danger of severe declines in creativity (Plucker, 1999). There were 10 non-gifted students and 24 gifted students. Children were divided into these two groups to assess if giftedness is correlated to creativity. Creativity was assessed through their scores on the *Alternative Uses Test,* which measures divergent thinking. For the purpose of this experiment, *Creativity* was defined as the cognitive process of divergent thinking. *Creativity* was defined as the ability to generate as many possible solutions to a problem. The researcher was identifying if school achievement gave a gifted student a higher score. The middle school selected for this experiment was located in the populous city of Los Angeles, California. A majority of students were

Caucasian (52%), followed by Hispanic (15%), Asian (12%), African American (15%), and Other (predominantly Armenian, 6%). While the sample was likely to include a cross section of ethnic groups, it was unclear how much these ethnic groups are represented in this sample. Because students have a rigorous schedule, they were self-selected from an after-school program. Subjects' parents were given a consent form to read and sign before their children can take part in this study. The children gave their verbal assent to participate.

Design

This was a non-experimental design, as it did not involve a manipulation of the situation, circumstances, or experience of the participants. The independent variable was the students' status (gifted vs. non-gifted). The dependent variable was the student's scores on the *Alternative Uses Test* (Guilford et al., 1978). The experiment looked at the differences in scores on the *Alternative Uses Test* among each group (gifted vs. non-gifted). The two groups of students, gifted and non-gifted, students were matched on demographics (age, grade, gender). The experimenter looked at the relationship of students' giftedness to students' creativity.

Instrumentation

For the purposes of this study, *Divergent Thinking* was defined as the ability to generate ideas that reflect originality, fluency, flexibility and elaboration. Students' divergent thinking abilities were measured by the *Alternative Uses Test* (Guilford et al.,

1978), one of a battery of tests first developed by Guilford in 1960. Wallach and Kogan (1965) utilized the tool in a subsequent study—following Mednick's (1962) definition of creative thinking. Mednick's (1962) definition of creative thinking suggested that "the forming of associative elements into new combinations which either meet specified requirements or are in some way useful" (p. 221). The measurement of the uniqueness of ideas, originality, fluency, and elaboration provides an assessment independent of intelligence tests. The test was presented, in a game-like manner, to ensure a lack of pressure and to obtain a sense of playfulness. The test was also used without time restraints—allowing the children to feel more relaxed.

Due to busy schedule of both gifted and non-gifted students, the test was timed in this current study. An hour gave students more than adequate time to generate answers per each question (approximately six minutes per item). The test consisted of 10 questions that start with, "Name all the uses for (an object)." The object was a common object, found in the home, that all students could presumably possess knowledge of—such as a shoe or a newspaper. The *Alternative Uses Test* (Guilford et al., 1978) measures four items: *fluency*—number of answers; *flexibility*—number of categories; *originality*—answer being used 5% in comparison to all answers; and *elaboration*—detailed answers. Although the four domains have been used widely, some tests of creativity have been criticized for their manner in assessing validity.

There has been criticism of unknown reliability and validity with creativity tests; however, it might be difficult to establish clear and concise psychometric data on reliability (Baer, 1991; Plucker & Renzulli, 1999; Rastogi & Sharma, 2010). Most

creativity tests have not significantly changed since the 1960s (Silvia et al., 2008). Results from testing 489 children in grades five through seven, indicated a reliability of .53 to .63 (Guilford et al., 1978). From those results, sixth graders had a reliability estimate of .85 when given a six item AUT exam, a .89 when given a nine item AUT exam, and a .91 when given a 12 item AUT exam (Guilford et al., 1978). The test-retest reliability (of the more recent Torrance Test of Creativity, which utilizes the *Alternative Uses Test*) is moderate to high (.5 to .93.) The investigator used a 12 item AUT exam (Treffinger, 1985).

It is difficult to compute psychometric data due to the nature of scoring the data (fluency, flexibility, originality, and elaboration). Nevertheless, creativity tests—specifically divergent thinking tests—are frequently used by educators, experimenters, and researchers (Harrington, Block, & Block, 1992; Plucker & Renzulli, 1999; Runco, 1993). The AUT is currently still being used for research in divergent thinking (Farah, Haimm, Sankoorikal, Smith, & Chatterjee, 2009; Hoff & Carlsson, 2011).

Procedure

Sixth, Seventh, and Eight grade students—24 of them gifted and 10 of them non-gifted—all at the same school were tested in the same class. Participants' parents were given a consent form to read and sign before their children took part in this study. Parents filled out a demographic survey. The researcher told participants that they are participating in a creativity activity, which is open-ended, and that there was no one correct answer. The researcher individually asked each child if he or she would like to

participate. The researcher then gave the *Alternative Uses Test*, comprised of 12 questions for each student in the class. The test took an hour to complete. The researcher informed the class of this before passing out the test to the students. The debriefing included questions that assessed if the child felt threatened in any way—as well as questions asking what they enjoyed, disliked, and found challenging about the test and the whole project.

Chapter 4: Results

The researcher tested 34 students on their divergent thinking through the *Alternative Uses Test* (AUT). This test measured the two main components that comprise creativity: fluency and flexibility. The students were assessed by their California Standards Test CST scores in Math and English to be deemed "gifted" or "non-gifted." If the students had a 350 or higher in either Math or English on their CST, they were deemed "gifted." If their scores were lower than 350 on either Math or English on their CST, they were deemed "non-gifted."

Descriptive Data with Outlier

Descriptive statistics demonstrate that there were more gifted students (70.6%) than non-gifted students (29.4%). As Table 2 demonstrates, the skewness and kurtosis were greater than 1.00 for Total Fluency (*Skew* = 1.05) (*Kurtosis* = 2.17), indicating the presence of an outlying scores in Total Fluency (Meyers, Gamst, & Guarino, 2006). In light of this, subsequent data anlyses were conducted with the outlying score included, and then conducted with it excluded. Table 2 presents the sample descriptive frequencies with the outlying score, and Table 3 with it removed. As Table 3 demonstrates, the removal of the outlier led to skewness between 1 and -1, the normal range, suggesting the rest of the scores are normally distributed. Table 4 indicates the students by their status (gifted, non-gifted) to view the differences between both groups on Total Fluency and Total Flexibility. The gifted students scored higher as a group on both Total Fluency scores ($M = 39.74$, $SD = 19.38$) $F(1, 32) = 5.63$, $p < .05$, partial $\eta^2 = .15$ and Total

Flexibility scores (M = 31.96, SD = 11.38) than the non-gifted group Total Fluency (M = 29.38, SD = 11.23) and Total Flexibility (M = 21.90, SD = 6.31) $F(1, 32) = 7.53$, $p < .05$, partial $\eta^2 = .19$ (see Table 4). Therefore, the outlying score (Total Frequency = 144) was removed from the gifted status group. Descriptive statistics of both gifted and non-gifted students for total fluency and total flexibility are presented with cumulative CST scores for English (M = 387.48) and Math (M = 379.15) in Table 5. Table 6 presents the correlation between student's AUT scores (Total Fluency, Total Flexibility) and their CST scores (English and Math). The correlation shows the strong correlations of CST English scores to Total Flexibility (r = .49) and Total Fluency (r = .52). The tables following Table 8 present the descriptive statistics, as well all statistical analyses without the outlying score.

Table 1
Descriptive Frequencies of Gifted and Non-Gifted Groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Gifted	24	70.6	70.6	70.6
	Non-Gifted	10	29.4	29.4	100.0
	Total	34	100.0	100.0	

Table 2

Distribution Frequencies for Both Gifted and Non-Gifted Students on Two Factors with Outlying Scores

		TotalFl	TotalFlex
N	Valid	34	34
	Missing	0	0
Mean		39.7353	29.3824
Std. Deviation		19.37713	11.23311
Skewness		1.050	.437
Std. Error of Skewness		.403	.403
Kurtosis		2.166	-.653
Std. Error of Kurtosis		.788	.788
Minimum		13.00	12.00
Maximum		104.00	55.00

Note. TotalFl = Total Fluency, TotalFlex = Total Flexibility

Table 3

Distribution Frequencies for Gifted and Non-Gifted Students on 2 factors without Outlying Scores

		TotalFl	TotalFlex
N	Valid	33	33
	Missing	0	0
Mean		37.7879	28.9091
Std. Deviation		15.94474	11.05770
Skewness		.162	.516
Std. Error of Skewness		.409	.409
Kurtosis		-.920	-.450
Std. Error of Kurtosis		.798	.798
Minimum		13.00	12.00
Maximum		66.00	55.00

Note. TotalFl = Total Fluency, TotalFlex = Total Flexibility

Table 4

Descriptive Statistics for Gifted and Non-Gifted Groups (with Outlier Removed)

	Status	Mean	Std. Deviation	N
TotalFl	Gifted	41.91	15.99	24
	Non-Gifted	28.30	11.63	10
				34
TotalFlex	Gifted	31.96	11.38	24
	Non-Gifted	21.90	6.31	10

Note: TotalFl – Total Fluency; Total Flex – Total Flexibility

Preliminary Analyses with the Sample

The racial demographics of the students were as follows: 12% Asians, 15% African Americans, 15% Hispanics, 52% Caucasian, and 6% of another race (predominantly Armenian) (see Table 5). Chi Square Test for Independence Gifted Status and Participant Ethnicity revealed that there was no relationship between participant Giftedness and ethnicity $X^2(1) = 2.84$, $p > .05$.

Table 5

Descriptive Statistics for Gifted and Non-Gifted Groups on CST Scores (with Outlier Removed)

	Mean	Std. Deviation	N
TotalFl	37.7879	15.94474	33
TotalFlex	28.9091	11.05770	33
CSTEng	387.4848	74.70572	33
CSTMath	379.1515	73.61264	33

Note. TotalFl = Total Fluency, TotalFlex = Total Flexibility

Gender by Gifted Status

There were 13 boys and 21 girls tested all together from the sample. The distribution shows that, although there were more girls than boys, there were no statistically significant differences by Gender between Total Fluency and Total Flexibility X^2 (4) = 3.17, $p > .05$ (see Table 6).

Table 6

Correlations for Total Fluency and Total Flexibility on Cumulative CST Scores

		TotalFl	TotalFlex	CSTEng	CSTMath
TotalFl	Pearson Correlation	1	.959**	.523**	.403*
	Sig. (2-tailed)		.000	.002	.020
	N	33	33	33	33
TotalFlex	Pearson Correlation	.959**	1	.488**	.399*
	Sig. (2-tailed)	.000		.004	.022
	N	33	33	33	33
CSTEng	Pearson Correlation	.523**	.488**	1	.846**
	Sig. (2-tailed)	.002	.004		.000
	N	33	33	33	33
CSTMath	Pearson Correlation	.403*	.399*	.846**	1
	Sig. (2-tailed)	.020	.022	.000	
	N	33	33	33	33

Note. TotalFl = Total Fluency, TotalFlex = Total Flexibility

Table 7

Chi Square Test for Independence between Giftedness and Student Ethnicity

		Race					Total
		Asian	African American	Hispanic	Caucasian	Other	
Status	Gifted	2	3	3	12	4	24
	Non-Gifted	0	2	2	6	0	10
Total		2	5	5	18	4	34

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	3.173	4	.529

$X^2(4) = 3.17$, $p > .05$

Table 8

2 X 2 Chi Square Test of Independence of Gender by Gifted and Non-Gifted Groups

		Status		
		Gifted	Non-Gifted	Total
GenderChild	male	7	6	13
	female	17	4	21
Total		24	10	34

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.842	1	.092
N of Valid Cases	34		

X^2 (4) = 2.84, $p > .05$

Factor Analysis

Initially, the factorability of the 4 items (Fluency, Flexibility, Elaboration, and Originality) was examined. Due to the fact that there were only 34 students and four

dependent variables, the number of dependent variables needed to be reduced in order to maintain maximum statistical power. This was done by using an exploratory factor analysis of the AUT.

An exploratory factor analysis of the four DV's (Fluency, Flexibility, Elaboration, and Originality) was conducted to determine which of the four best represented divergent thinking. The results indicated that: only one factor was derived; and the two DV's that were the strongest indicators of divergent thinking were Total Flexibility and Total Fluency (see Table 9). The original intention was to use Varimax rotation; but since there was only one factor extracted, there was no factor rotation. However, because the purpose of the factor analysis was not to investigate the AUT's factor structure, but to identify the strongest loading variables, the measure of sampling adequacy was not of immediate consideration; as indicated in Table 4, the Kaiser Myer Olkin (KMO) statistic showed less than adequate measure of sampling adequacy at .655 (Meyers et al., 2006) though the communalities were sufficiently high (see Appendix A, Tables A, B).

The results of the factor analysis indicated that one factor accounted for 72.3% of the variance (see Appendix A, Table C). Because there was no factor rotation (see Table 12), there is no Rotated Factor Matrix. The two variables, Total Fluency (.912) and Total Flexibility (.910), were the strongest loading outcome variables (see Appendix A, Table D), and were subsequently the only two dependent variables used in the tests of hypotheses.

Table 9

Correlation Matrix of AUT Fluency, Flexibility, Elaboration, and Originality

		TotalFl	TotalFlex	TotalElab	TotalOrig
Correlation	TotalFl	1.000	.897	.344	.760
	TotalFlex	.897	1.000	.414	.704
	TotalElab	.344	.414	1.000	.581
	TotalOrig	.760	.704	.581	1.000
Sig. (1-tailed)	TotalFl		.000	.023	.000
	TotalFlex	.000		.007	.000
	TotalElab	.023	.007		.000
	TotalOrig	.000	.000	.000	

Note. Fl = Fluency; Flex = Flexibility; Elab = Elaboration; Orig = Originality

Hypothesis Tests

Once the appropriate dependent variables were selected, the test of the hypotheses were conducted; specifically, a Two Group multivariate analysis of variance (MANOVA), with Status of Giftedness with Two Levels (gifted, not gifted), was conducted on Total Fluency and Total Flexibility with the outlying score removed. However, Levene's Test of Equality of Error Variances indicated that the variances between groups for Total Flexibility were not equal $F(1, 31) = 4.97$, $p < .05$ (see Table 14). As such, Pillai's Trace was used as the multivariate test statistic (Meyers et al., 2006). The results indicated that the gifted and non-gifted groups differed on at least one dependent variable (Wilk's $\lambda = .19$, $p < .05$, partial $\eta^2 = .19$). Pillai's Trace showed that the gifted and Non-Gifted students differed on at least one dependent variable (Pillai's Trace = .18, $p < .05$, partial $\eta^2 = .18$). The Two Group MANOVA revealed that the

Gifted Group evidenced higher Total Fluency scores (M = 41.91, SD = 15.99) than the Non-Gifted Group (M = 28.30, SD = 11.63), as well as higher Total Flexibility scores Gifted Group (M =31.96 SD = 11.38) and Non-Gifted Group (M = 21.9, SD = 6.31) F (1, 31) = 5.85, $p < .05$, partial $\eta^2 = .16$ (see Table 4).

Table 10
Box's Test of Equality of Covariance Matrices

Box's M	12.113
F	3.676
df1	3
df2	5526.799
Sig.	.012

Table 11
Two Group MANOVA of Total Flexibility and Total Fluency by Giftedness Status with Outlying Score

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.868	102.188[b]	2.000	31.000	.000	.868
	Wilks' Lambda	.132	102.188[b]	2.000	31.000	.000	.868
	Hotelling's Trace	6.593	102.188[b]	2.000	31.000	.000	.868
	Roy's Largest Root	6.593	102.188[b]	2.000	31.000	.000	.868
Status	Pillai's Trace	.191	3.650[b]	2.000	31.000	.038	.191
	Wilks' Lambda	.809	3.650[b]	2.000	31.000	.038	.191
	Hotelling's Trace	.235	3.650[b]	2.000	31.000	.038	.191
	Roy's Largest Root	.235	3.650[b]	2.000	31.000	.038	.191

Table 12

Total Flexibility and Total Fluency by Giftedness Status with Outlying Score

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	TotalFl	1852.518[a]	1	1852.518	5.625	.024	.150
	TotalFlex	793.129[b]	1	793.129	7.529	.010	.190
Intercept	TotalFl	37410.635	1	37410.635	113.601	.000	.780
	TotalFlex	20889.600	1	20889.600	198.305	.000	.861
Status	TotalFl	1852.518	1	1852.518	5.625	.024	.150
	TotalFlex	793.129	1	793.129	7.529	.010	.190
Error	TotalFl	10538.100	32	329.316			
	TotalFlex	3370.900	32	105.341			
Total	TotalFl	66073.000	34				
	TotalFlex	33517.000	34				
Corrected Total	TotalFl	12390.618	33				
	TotalFlex	4164.029	33				

Table 13

Two Group MANOVA of Total Flexibility and Total Fluency by Giftedness Status without Outlying Score

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.867	97.917[a]	2.000	30.000	.000	.867

Table 14

Levene's Test of Equality of Error Variances

	F	df1	df2	Sig.
TotalFl	1.245	1	31	.273
TotalFlex	4.969	1	31	.033

Note. TotalFl = Total Fluency; TotalFlex = Total Flexibility

Table 15

Total Flexibility and Total Fluency by Giftedness Status without Outlying Score

	Wilks' Lambda	.133	97.917[a]	2.000	30.000	.000	.867
	Hotelling's Trace	6.528	97.917[a]	2.000	30.000	.000	.867
	Roy's Largest Root	6.528	97.917[a]	2.000	30.000	.000	.867
Status	Pillai's Trace	.181	3.316[a]	2.000	30.000	.050	.181
	Wilks' Lambda	.819	3.316[a]	2.000	30.000	.050	.181
	Hotelling's Trace	.221	3.316[a]	2.000	30.000	.050	.181
	Roy's Largest Root	.221	3.316[a]	2.000	30.000	.050	.181

Source	Dependent Variable		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	dimension1	TotalFl	1291.589[a]	1	1291.589	5.850	.022	.159
		TotalFlex	704.871[b]	1	704.871	6.812	.014	.180
Intercept	dimension1	TotalFl	34359.710	1	34359.710	155.635	.000	.834
		TotalFlex	20215.780	1	20215.780	195.361	.000	.863
Status	dimension1	TotalFl	1291.589	1	1291.589	5.850	.022	.159
		TotalFlex	704.871	1	704.871	6.812	.014	.180
Error	dimension1	TotalFl	6843.926	31	220.772			
		TotalFlex	3207.857	31	103.479			
Total	dimension1	TotalFl	55257.000	33				
		TotalFlex	31492.000	33				
Corrected Total	dimension1	TotalFl	8135.515	32				
		TotalFlex	3912.727	32				

Chapter 5: Summary, Discussion, and Future Implications

Summary of Findings

It was hypothesized that gifted students would be able to think more divergently than their non-gifted peers. Although the full sample, containing 34 students, had one outlying score, the main analyses were conducted with the outlier and without the outlier. The present study indicated that student gender and ethnicity were unrelated to giftedness in this sample, although past research has shown inconsistency in both variables of demographics (Dudek, Strobel, & Runco, 1993; Paletz & Peng, 2009; Stoltzfus, Nibbelink, Vredenburg, & Thyrum, 2011). The results also indicated that gifted students evidenced greater fluency and flexibility than their non-gifted peers. Fluency is usually described as the central component to of divergent thinking (Hargreaves & Bolton, 1972). The results indicated that gifted students were able to generate many possible answers (fluency) and produce different categories of answers (flexibility) more than their non-gifted peers. Guilford (1959, 1979), Getzels and Jackson (1962), Torrance and Wu (1981), and Renzulli (1986) suggest that gifted children have higher abilities of creativity, which includes fluency and flexibility. If this assertion is true, then the present results are consistent with the notion that gifted students are more creative in fluency and flexibility than their non-gifted peers. The findings indicate that both fluency and flexibility are the strongest indicators of divergent thinking between fluency, flexibility, originality, and elaboration (Farah et al., 2009; Hommel, Colzato, Fischer, & Christoffels, 2011; Sternberg, 2001; Wallach & Kogan, 1965). The study also produced strong correlations for high school achievement (CST English) and both total fluency and flexibility. This

finding suggests that children with achievement scores in Math and English may have a greater capacity for divergent thinking.

Linking Results

Although the AUT Manual (1978) and the TTCT (1974) both found that demographic information such as SES and gender had little to do with creativity, Torrance did find that patterns of creativity differed across cultures (Paletz & Peng, 2009). Torrance (1971, 1973) and Kaltsounis (1974) found that African Americans scored higher on the TTCT than Caucasian children on Figural tests, but that Caucasians scored higher on verbal subtests. Torrance (1971) also reported no differences between lower and middle SES for both verbal and figural scores. Cultural differences such as gender roles, resources to education, and style of education make a difference in how creativity is implemented and prioritized in educational, personal, and professional success. For instance, Arab students score higher on figural tests than American participants (Paltez & Peng, 2009). In a recent study, Stoltzfus et al. (2011) found that college men scored higher than college women on the AUT, even though women have surpassed men in creative ability in past research (Reuter, Panskepp, Schnabel, Kellerhodd, Kempel, & Henning, 2005; Wolfradt & Pretz, 2001). When it comes to children, there is a tendency for girls to score higher than boys, especially in the early years of schooling, prior to 3rd Grade, especially in high SES populations. (Dudek et al., 1993).

The present results are consistent with past research which supports that gifted status students have higher levels of creativity (Fraiser et al., 1995; Kim, 2005; Sternberg, 2000; Renzulli, 1978) than non-gifted students. Historically, intelligence and creativity have often been compared (Gardner, 1983; Guilford, 1950; Runco, 1993; Sternberg, 2001; Terman, 1954). Traditional IQ tests do not measure divergent thinking (Kim, 2005). Gifted students have historically been chosen by their intellectual assessment (Tanenbaum, 2000; Terman, 1954; Wallach, 1985). Terman was the first to mark giftedness as those who are able to score in the top one percent of general intellectual ability (IQ) (Brody, 1997). Since then, Marland (1972) generated a broader point of view of giftedness in which he indicated six domains, in which it could manifest, creativity being one of them. From those results, sixth graders had a reliability estimate of .85 when given a six-item AUT exam, a .89 when given a nine-item AUT exam, and a .91 when given a 12-item AUT exam. Stimonson (1968) used measures of self-concept, divergent thinking, intelligence, and cognitive complexity in a factor analysis based on data from 106 male college students and the AUT loaded .72 on the divergent-thinking factor (Guilford et al., 1978). Kim (2005) found the average correlation between divergent thinking tests and intelligence to be .17. The students, who have been tested in this experiment, were chosen based off of achievement scores (CST), which is consistent with many schools' standards for giftedness. The CST scores revealed a strong relationship towards total fluency (r = .52) and total flexibility.

McGinn, Viernstein, and Hogan (1980) demonstrated that fostering divergent thinking could improve verbal and reasoning ability for adolescents. The strong

correlation of verbal scores to fluency should not come as a surprise as the AUT is used as a verbal creativity test, as opposed to nonverbal or figural test (Glover et al., 1989).

Interpretation of Results

It has been difficult to assess how one's IQ is related to one's creative potential. The threshold theory holds that one who scores below a critical IQ level of 120 has the potential to become creative, but one who scores above 120 does not have this potential (Runco & Albert, 1986). Much like the controversy surrounding creativity, there are inconsistent results regarding the threshold theory (Kim, 2005; Runco & Albert, 1986); that is to say, most studies have found modest relationships between creativity and intelligence, but only a few studies have found that creativity is independent from intelligence (Silvia et al., 2008). The AUT Manual (1978) states that the typical correlations between the AUT and IQ lies are low (.2 to .3), and warns that a high score in AUT (divergent production) indicates a high IQ, but a high IQ does not necessarily indicate a high status in divergent production. Anastasia and Schaefer (1971) found that AUT scores correlated .21 with grade-point average and .27 with IQ. Bowers (1960) administered the AUT to 150 children in elementary school and found that it correlated .26 with the Stanford-Binet IQ. Steinberg et al. (1963) found that the flexibility score of 96 nine-year-olds correlated .33 with IQ. More recently, Preckel, Holling, and Wiese (2006) tested 1,328 gifted and non-gifted students on their fluid intelligence and creativity and found their results contradicted the threshold theory. Students' intelligence was tested using a test of fluid intelligence and the Berlin structure-of-intelligence test

(which assesses memory, speed, processing capacity, and creativity in verbal, figural, and numerical content domains). Preckel et al. (2006) applied correlation analysis and a confirmatory approach of multi-group comparisons using structural equation modeling to investigate the threshold theory, which was not supported. The results indicated that correlations between creativity (divergent thinking) and intelligence are of comparable size throughout the whole ability range for students, ages 12 to16 years. The current results are inconsistent with the threshold theory: the student's high scores and high achievement scores may also be inconsistent with the low correlation of the AUT scores and IQ. Although there is a lack of agreement in the intelligence and creativity debate, it seems that there is a relationship. In order to do well in school, a student must attain knowledge, which consists of both crystallized and fluid intelligence. Gifted students seem to grasp what is necessary in school achievement, but they can also go beyond simply memorizing facts. Gifted students have a vast knowledge that they can access to generate many possible answers. Thereby, gifted students hold the knowledge base to be able to think of possibilities that they know do not exist. A non-gifted student presumably does not have as extensive of a knowledge base, and therefore cannot access as much verbal and visual possibilities. This was speculated by the lack of elaboration and originality by the non-gifted students.

Vincent, Decker, and Mumford (2002) examined the relationship among intelligence, expertise, and divergent thinking as they influence creative problem solving and performance in a sample of 110 military leaders. They found that divergent thinking exerted unique effects on creative problem solving that could not be attributed to

intelligence or expertise. Divergent thinking had a substantially stronger direct effect on idea generation than intelligence or expertise, as well as a high correlation to intelligence *(r* = .73) (Vincent et al., 2002). The controversy over creativity and intelligence is far reaching, and due to the lack of an operational definition for creativity (as discussed in chapter 2), there is dispute over construct validity (Silvia et al., 2008). This controversy has not stopped researchers from attributing idea generation to intelligence, specifically giftedness.

There has been a long-standing debate of nature versus nurture towards intelligence. Despite several theories of giftedness—i.e., The Structure of Intellect or SOI model (Guilford, 1967); The Pentagonal Implicit Theory of Giftedness (Sternberg, 1993); and the Three Ring Conception of Giftedness (Renzulli, 1986)—which explain characteristics or attributes that qualify one as being gifted, there has yet to be a thorough cognitive theory that explains how those with gifted abilities have an advantage over those without gifted abilities. A high level of fluid intelligence is implied in giftedness (Holling & Kuhn, 2008; Roznowski, Reith, & Hong, 2000) and practice leads to perfection (Csikszentmihalyi, 1996; Ericson, Krampe, & Tesch-Romer, 1993; Gardner, 1983). Newton took 20 years to focus his ideas into a book of gravity and motion; this same determinism is seen in gifted adults. Gifted children have atypical brain organization and may have enhanced right-hemisphere development (Winner, 2000). Wilkinson (1993) reported sharp discrepancies between verbal and performance IQ with children who possessed an IQ of 120 or higher. Achter, Lubinski, and Benbow (1996) found that 42% of students scoring at the top .5% on the SATs had math and verbal SAT

scores over one standard deviation apart, displaying support for domain specific giftedness. From investigating intelligence and creativity, Yong (1994) deduced that it was probable for students with high intelligent to have higher verbal fluency than students who are less intelligent. This superiority in verbal skills could explain their higher verbal creativeness. With this information, it is possible that the students, who were gifted and scored highly on the AUT, might be more verbally gifted than mathematically gifted.

Although IQ scores were not included in the present research, the participating children must have shown high grades and achievement to be considered "gifted." In lieu of gifted children possessing both creativity and high intelligence, however, the threshold theory asserts that there is a boundary between the two (Runco & Albert, 1986). Runco and Albert (1986) administered five divergent thinking tests to 228 school children (consisting of 5th, 6th, 7th, and 8th graders) to assess the threshold theory of creativity; their results did not support the threshold theory. The five divergent tests were from the battery developed by Guilford et al. (1978) and were calculated within four IQ levels and within California Achievement Test quartiles.

The present study tested 34 gifted and non-gifted students (consisting of 6th, 7th, and 8th graders) to determine if giftedness had an impact on creativity, using the AUT. The present results are consistent with the idea that students who have achieved high scores on a state exam are able to be more creative than their peers, thereby challenging the threshold theory. The current results perhaps also point out that those with outstanding IQ's possess higher levels of divergent thinking than their non-gifted peers.

Limitations

The sample size (N = 34) was small and would have been a better indicator of results had it achieved a sample size of 60 or above; however, reducing the key variables down to Fluency and Flexibility did allow for an adequately powerful test of divergent thinking. There was a larger sample of gifted students (n = 24) than non-gifted students (n = 10). The participating students came from a high SES background, which could be a controlled variable in future studies by sampling from various schools, located in diverse neighborhoods. Past and current research has assessed that the higher the children's SES, the higher they will score on a creativity test (TTCT) (Dudek et al., 1993). The participant's age (11–13 years old) was also a limitation to generalizability, as the AUT can be used for all age groups, but would yield different results. The AUT does not specify an age, but recommends that the test be used in a group setting. Students in the third to fourth grade "slump," as mentioned in the introduction, would have been advantageous to use, as they have not sharpened their abstract reasoning skills, but could have yielded significant, differing results. There was only one school used in the present study, and future research should focus on more schools located in various parts of the country.

There are complications with using the AUT, as it was developed in 1967, and can lead to experimenter bias; for example, there is some subjectivity in discerning a viable from non-viable answer, even though the AUT manual suggests how to ascertain an acceptable answer from an unacceptable answer. The AUT manual suggests that a viable answer must be different from the other answers listed, must be achievable, and cannot be

vague. These instructions can be subject to experimenter bias and have caused criticism among those who study creativity assessment. Since creativity testing has not changed much since the 1960s, researchers have been apt to create new scales of subjectivity (Silvia et al., 2008).

Plucker, Beghetto, and Dow (2004) warn researchers against using scores on creativity measures as the sole definition of creativity. In testing, more indicators of gifted status can be used as continuous variables with the AUT. It would be advantageous to group students into low, average, and high creativity, accrue their giftedness statuses and test them on IQ and achievement to see if they correlate with creativity scores. These conditions would better ascertain if the threshold theory holds true.

Broad Implications

Future studies should focus directly on IQ and creativity. Acquiring IQ scores along with a slew of creativity tests—Remote Association Task (1962), Wallach and Kogan (1965), and Torrance Test of Creative Thinking (1974)—could help to get a sharper, more direct understanding of the correlation of intelligence to giftedness. Like Torrance and Wu (1981), who found in a longitudinal study that adults who were assessed as children into "high intelligence low creativity" or "low intelligence high creativity" had more creative accomplishments if they belonged to the latter group, a longitudinal study would serve as beneficial. Future research should contain four categories: "low intelligence, low creativity," "low intelligence, high creativity," "high

intelligence, high creativity," and "high intelligence, low creativity" to determine if the threshold theory is upheld as one ages. Because past research (Achter et al., 1996; Winner, 2000) has evidenced a stark difference between those who are verbally gifted and mathematically gifted, this experiment should be conducted with a divergent test that encompasses spatial and/or numerical content (such as: Symbol completion, object design, puzzled with numbers, inventing telephone numbers).

Another facet that would cover the holistic approach to creativity would be personality testing. Gifted students tend to show more curiosity, an open attitude toward experiences and ideas, and willingness to take risks (Renzulli, 1986); in fact, creative personalities often have a sense of duality in their nature. This duality is expressed in ambition and selflessness, passion and objectivism, playfulness and rebelliousness (Csikszentmihalyi, 1996). "Divergent thinking is often perceived as deviant by the majority, and so the creative person may feel isolated and misunderstood" (Csikszentmihalyi, 1996, p. 74). Ironically, this misconception occurs commonly in school settings. Carl Rogers (1974) asks, "Can I make a place for the creative person?" This question from the past is still relevant in our school system. Including creativity in standardized assessments for school admissions could help to reduce bias, thereby reducing ethnic differences and predicting more accurate admissions tests (Kaufman, 2010). It is imperative that we as a society look at the curious, the rebellious, and the misunderstood child, and explore what they can offer us. After all, the Einsteins, the Gandhis, and the Picassos have made large impacts in society.

Implications for Clinical Psychology

Creativity is not just for the schoolyard—it is an important facet of business, as well as everyday life. Creativity can provide the clinical psychology setting with beneficial treatment plans. Creativity has been shown to increase physical health, generate a higher state of general wellbeing, increase social harmony, improve mood, and reduce personal stress (Kaufman, 2010). The AUT specifically uses verbal and visual cues to elicit responses from participants. Using the AUT in a therapeutic setting could serve many advantages to both the client and therapist. For instance, a client who scores highly on the AUT may be more verbally motivated in therapy and could describe their struggles in more details, which would help dream analysis, art therapy, existential themes, and sensory images. The AUT could also help to assuage parents who fear that their child's creativity will suffer due to Attention Deficit Hyperactivity Disorder (ADHD) medication. Parents seeking to place their children into prestigious schools could use the AUT for evidence of lateral thinking. Because the AUT is a tool designed to generate ideas and think unconventionally using real-world concepts, a high fluency score would indicate lateral thinking, a skill that is highly valuable to schools seeking a well-rounded candidate. The AUT could also be used to help motivate clients with depression or anxiety to seek personal growth and self-esteem.

"Flow" is what Csikszentmihalyi (1996) defines as an optimal experience in which an activity feels effortless, yet with a highly focused state of conscious. This experience seemed to hold true across culture, gender, and age and is different for every person. Whether dancing, rock climbing, or solving math equations, people maintain a balance

between challenges and skills and are rewarded with the experience itself (Csikszentmihalyi, 1996). This sense of timelessness and joy is something anyone and everyone can partake in. So why not make it a part of therapy? Included in a treatment plan or discovered in a session, one's passions can be the secret to happiness, even if for an hour. After all, play therapy is a creative form of therapy psychologists applied to communicate with children. The field of psychology has long known that therapy needs a bit of innovation for clients that don't fit the models of particular mental illness. Creativity has been used to help individuals suffering from alcoholism, grief, and trauma (Plucker et al., 2004). Singer and Singer (1990) have reported that play therapy develops divergent thinking ability and flexibility in shifting between different types of thought.

Divergent thinking can help to foster creativity. Creativity is lacking in school systems due to traditional classroom organization, classroom curriculum, and an unclear understanding of the concept of creativity (Plucker et al., 2004). This lack of understanding has led most school psychologist to stay away from adopting creativity into their curriculum (Plucker et al., 2004). However, teachers who show a humanistic philosophical orientation have developed their own creative competencies, and implement specific creative methods such as: a motivational environment, inviting questions that enhance critical thinking and analysis, brainstorming, the use of play and fantasy, and explore outcomes and possibilities are more effective in enhancing students' creative abilities than teachers who follow more traditional instructional approaches (Esquival, 1995). School psychologists could potentially add the AUT to in addition to state achievement tests and IQ test to qualify for giftedness or advanced placement

courses in high school. Creativity, whether inborn or environmental, can be nurtured, encouraged, and modeled by schools, psychologists, parents, and businesses.

Creativity has been described as "survival" and "adaptive" (Csikszentmihalyi, 1996; Sriraman, 2005). In fact, creativity testing owes gratitude toward Guilford, who was asked by the government to create appropriate testing for fighter pilots. During World War II, the government did not feel that IQ testing was sufficient for real world application. The government wanted to test fighter pilots' ability to be creative when all obvious solutions were not available (Csikszentmihalyi, 1996). This intrinsic need to be creative should be explored, taught, and applied. Its implications are evident for education, successful careers, clinical psychology, and overall wellbeing.

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Appendix A: Additional Tables

Table A
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.655
Bartlett's Test of Sphericity	Approx. Chi-Square	92.963
	Df	6
	Sig.	.000

Table B
Communalities

	Initial	Extraction
TotalFl	1.000	.832
TotalFlex	1.000	.828
TotalElab	1.000	.413
TotalOrig	1.000	.816

Note. Fl = Fluency; Flex = Flexibility

Table C
Factor Analysis Eigenvalues of AUT Fluency, Flexibility, Originality, and Elaboration

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.890	72.259	72.259	2.890	72.259	72.259
2	.762	19.048	91.308			
3	.263	6.576	97.883			
4	.085	2.117	100.000			

Table D

Component Matrix of Fluency, Flexibility, Elaboration, and Originality

	Component
	1
TotalFl	.912
TotalFlex	.910
TotalElab	.643
TotalOrig	.903

Note. TotalFl = Total Fluency; TotalFlex = Total Flexibility; Total Elab = Total Elaboration; Total Orig = Total Originality

Appendix B: Institutional Review Board Addendum Approval

Investigator: Sheena Sachdev

Study Title: Divergent Thinking and Giftedness in Children

RE: Addendum 1 **Date:** March 6, 2012

The Investigator requests approval to include a demographic questionnaire with the Informed Consent form that parents will be signing for the study. The demographic questionnaire has been submitted for review. The Investigator also requests to test both sets of students (gifted and non-gifted) in the same classroom, instead of testing each set of students in separate classrooms. This has been addressed in the revised Consent form (rec'd 3/5/12).

I recommend expedited approval to this minor change to previously approved research.

Alicia Cook

Alicia Cook, CIP Director, Institutional Review Board

Appendix C: Informed Consent

Title: Divergent Thinking and Giftedness in Children

Investigators: S. Sheena Sachdev, M.A.

Dear Parents, we are asking you to let your child participate in a research study. Please take your time to read the information below and feel free to ask any questions before signing this document.

Purpose: I am assessing the ability of children in a gifted class and a non-gifted class to observe any differences in their ability to think creatively.

Procedures: Children in both the gifted class and the non-gifted class will be given a creativity activity. It simply asks the student to think of as many possible answers for all the uses of common objects, such as a brick or broom. There are no right answers. The activity will take place on February 8, 2012. The activity should take up to an hour.

Demographic Survey: Included with your consent is a brief demographic survey. By filling out the survey and signing your consent, your child will be eligible to participate in this research study (along with their verbal assent). The survey will help to understand if other variables, such as income or education, are related to creativity.

Risks to Participation: There are no physical or emotional risks attached to this project.

Benefits to Participants: Your children may not directly benefit from this study. The project gives students a chance to use their imaginations. The test is also not graded, which provides a more enjoyable atmosphere, where there are no wrong answers. I hope the information learned from this study may benefit society in our understanding of the importance of creativity in children.

Alternatives to Participation: Participation in this study is voluntary. Your children will have the choice to withdraw from study participation at any time without any penalty.

Confidentiality: All test scores and names will be kept confidential. The study is measuring the gifted and the non-gifted classes; therefore students will not be identified on an individual basis.

Questions/Concerns: If you have any questions or concerns, please contact me:

ssheenasachdev@gmail.com

If you have questions concerning your rights in this research study you may contact the Institutional Review Board (IRB), which is concerned with the protection of subjects in research project. You may reach the IRB office Monday-Friday by calling 312.467.2343 or writing: Institutional Review Board, The Chicago School of Professional Psychology, 325 N. Wells, Chicago, Illinois, 60654"

Consent

Your child's consent will be verbally communicated on the date of the study. Children will be given an example of what the test will include. Each child will be asked by the investigator if they would like to participate in a study that measures creativity. Participation is voluntary.

Parent/Guardian/Legally Authorized Representative:
I give my permission for my child/relative to participate in this research project.

Signature of Parent/Guardian/Legally Authorized Representative:

_____
Date: _____

Signature of the Person Obtaining Consent: _____
Date: _____

Appendix D: Demographic Survey

Dear Parents,

Please take five minutes of your time to fill out this demographic questionnaire.

Thank you.

What is your sex?

o Male

o Female

In what year were you born? ____

Please specify your race.

o American Indian or Alaska Native

o Asian

o Black or African American

o Hispanic

o Native Hawaiian or Other Pacific Islander

o White

o Other _____

What is your marital status?

o Now married

o Widowed

o Divorced

o Separated

o Never married

What is your primary language?

o English

o Spanish

o Other _____

What is the highest degree or level of school you have completed?

o No schooling completed

o Nursery school to 8th grade

o 9th, 10th or 11th grade

o 12th grade, no diploma

o High school graduate - high school diploma or the equivalent (for example: GED)

o Some college credit, but less than 1 year

o 1 or more years of college, no degree

o Associate degree (for example: AA, AS)

o Bachelor's degree (for example: BA, AB, BS)

o Master's degree (for example: MA, MS, MEng, MEd, MSW, MBA)

o Professional degree (for example: MD, DDS, DVM, LLB, JD)

o Doctorate degree (for example: PhD, EdD)

Are you currently...?

o Employed for wages

o Self-employed

o Out of work and looking for work

o Out of work but not currently looking for work

o A homemaker

o A student

o Retired

o Unable to work

What is your total household income?

o Less than $19,999

o $20,000 to $29,999

o $30,000 to $39,999

o $40,000 to $49,999

o $50,000 to $59,999

o $60,000 to $69,999

o $70,000 to $79,999

o $80,000 to $89,999

o $90,000 to $99,999

o $100,000 to $149,999

o $150,000 or more

What grade is your child in?

o 6th

o7th

What was your child's score on the current California Standards Test? _____

Appendix E: Verbal Assent Script for Obtaining Informed Consent

Divergent Thinking and Giftedness in Children
S. Sheena Sachdev

"Hello, my name is Sheena Sachdev. I am a graduate student at The Chicago School of Professional Psychology and I am undertaking research that will be used in my dissertation."

"I am studying creativity and intelligence. A big part of creativity is being able to think of as many possible solutions to a problem. This means there is not only one answer to a problem! Each one of you will be participating in an activity. This activity will take approximately an hour."

"The information you share with me will be confidential, which means no one will know about it except you, me, and my dissertation team. If you do not want to participate in the activity, it is o.k."

"If you have any additional questions concerning this research or your participation in it, please feel free to contact me. (I will write my email, my dissertation chair's email, and my cell phone on the chalk board).

"Does anyone have any questions?"

"Before we begin the test, I must first go around and get your verbal permission that you would like to participate in this study. It is completely voluntary and if you do not want to participate, that is o.k."

Each child will be asked: "Would you like to participate in this study?"

(After attaining verbal assent from all the children)

"Let's begin." (I will pass out the tests to the children that have given me their verbal assent). "Remember, there are no wrong answers. Take your time. You will have a full hour. I will pick up the papers at the end of the hour."

Appendix F: Sample Questions from Alternative Uses Test

Name:

Grade:

Please circle one: I am in the gifted program I am not in the gifted program

Alternative Uses Test

Name all of the uses for a **SHOE** (used as footwear):

Name all of the uses for a **BUTTON** (used to fasten things):

Name all of the uses for a **KEY** (used to open a lock):

Name all of the uses for **EYEGLASSES** (used to improve vision):