ABSTRACT

FU, JINGYUAN. Assessing the Impact of Study Abroad Experience on the Creative Abilities of Design Students. (Under the direction of Arthur Rice).

Researchers have defined creativity as the ability to generate novel and useful ideas or solutions to everyday problems (Amabile, 1996; Sternberg, 1999). The development of an individual’s creativity is arguably one of the most critical elements of design education. A number of recent studies have indicated that exposure to other cultures can enhance some aspects of creativity. Such exposure allows individuals to acquire knowledge that contrasts with their conventional ideas and actions. This exposure can help people break traditional thought patterns restrained by culture (Cheng, & Leung, 2012; Leung, Maddux, Galinsky & Chiu, 2008; Paletz & Peng, 2008). However, very few studies have addressed the impact of such exposure on students participating in design programs. This study concentrates on a specific type of cross-cultural exposure, a design-based study abroad experience. The NC State Prague Institute served as the study site; all study participants (sample size, n= 131) were undergraduate and graduate students in a variety of design majors in the NC State University College of Design.

A comprehensive pre- and post-survey method collected data on both study abroad participants and a control group consisting of design students who did not attend a study abroad program. A series of validated tests, including Remote Associate Test, Similarity Test, and NEO-PI Openness Test, evaluated various aspects of creativity. Study findings identify the nature of the study abroad experiences’ impact on specific creativity attributes. The analysis results show that design students attending the
study abroad program showed statistically significant improvement in all five creativity aspects evaluated. Conversely, the control group showed no improvement in any of the creativity aspects over the same period, even decreasing in some aspects.
Assessing the Impact of Study Abroad Experience on the Creative Abilities of Design Students

by
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A dissertation submitted to the Graduate Faculty of North Carolina State University in partial fulfillment of the requirements for the degree of Doctor of Philosophy

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DEDICATION

Xin and Hongchu Fu

my parents

Rui Su

my husband

Flynn Su

my son

and to:

HuiHui

my best friend and a special family member
BIOGRAPHY

Jingyuan Fu is a Ph.D. candidate in College of Design, NC State University. She grew up in China and received her Bachelor of Architecture from Zhejiang University, China. Her undergraduate final design project *Dadongmen Pedestrian Shopping Complex* was published in *Future Arquitecturas* (Spain) in 2011. To continue her design education, she applied to the Master of Landscape Architecture in the College of Design, NC State University. While studying in the United States, she worked as a teaching assistant for both studio and design lecture classes. Her cross-cultural learning and education experience led to her research interest in cultural differences in design education. She finished her master’s study in Landscape Architecture in 2011 and decided to pursue a Ph.D. in Design.

Under the guidance of Prof. Art Rice, Jingyuan began her primary study by focusing on assessing the impact of cross-cultural experiences such as study abroad on students' creative thinking ability and the relationship of the openness scale to the experience. She presented her poster entitled “The Quest for the Measurement of Creativity in Design Education” at the 2014 Annual Conference of the Council of Educators in Landscape Architecture. Her abstract entitled “Design-Based Study Abroad: The Critical Step in Fostering Creative Designers” was accepted for the 2018 Annual Conference of the Council of Educators in Landscape Architecture. Her research goal is to learn the ways of evaluating and enhancing students' creativity and to build the link between cross-cultural experience and creative thinking ability.
Understanding whether and how cross-cultural experience enhances creative abilities will contribute to study aboard programs in design education.
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CHAPTER 1. INTRODUCTION

1.1 Research Background

Creativity is a concept associated with the generation of new ideas that are useful for a particular course of action. In most cases, the ideas are viewed as novel. An individual’s ability to come up with such concepts forms the basis of defining creativity (Amabile, 1996; Sternberg & O’Hara, 1999). Researchers have shown that individuals who are open to new experiences and who portray positivity toward the same are more creative than the rest of the populace (Baas, De Dreu & Nijstad, 2008; Feist, 1998; McCrae, 1987).

The influence of culture on a person’s creativity cannot be ignored. The concepts and ideas generated by a person are in some way associated with their cultural exposure; therefore, understanding this relationship is crucial because it can aid in determining the dynamic of cultural impact on an individual’s creativity levels (Chiu & Hong, 2005). Research has shown, experiencing different cultures positively impacts one’s creativity levels. Research has also indicated that experiencing different cultures improves an individual’s ability to generate new ideas, which can be applied in a practical environment. The cross-cultural knowledge gain helps individuals transform ordinary concepts into useful ideas that they can apply to their specific areas of expertise (Ip, Chen, & Chiu, 2006). An ordinary thing in one culture may hold a variety of implications and be useful in different ways to people belonging to different cultures.
This study uses primary research to explore the relationship among study abroad experience, metacognition, openness to new experience, and creativity. A study abroad program is used as a target group to detect whether exposure to different a culture changes college students' key personality trait (openness to new experience) and creative thinking abilities. The intent is to improve the understanding of how and to what extent study abroad experience fosters creativity and shed light on explaining why some people benefit more from study abroad experiences.

1.2 Study Significance

Design, as a field, requires creativity and innovation. Most research on creativity is rooted in the psychology, sociology, and education disciplines. However, the strong link between design and creativity is undebatable. William Miller (2004) summarizes the essence of design as “the thought process comprising the creation of an entity.” Design like creativity has no absolute boundaries or a clear-cut definition. Literature has identified a variety of definitions concerning these two concepts, which are sometimes even difficult to distinguish. Some authors confine themselves to definitions while others have established more holistic approaches (Merrill, 2014).

During the last couple of decades, creative processes have been extensively investigated to understand the occurrence of creative design and its relation to creative product development (Roy, 1993). Nigel Cross (1990) summarizes many of these findings when he states that designers generate unexpected, innovative solutions, bear with ambiguity, work with the inadequate material, and use
imagination and constructive prudence to practical issues. They also apply diagrams and other modeling media as a resource for problem-solving. Cross-lists skills that are mandatory for a designer, including the ability to "resolve ill-defined problems, adopt solution-focused strategies, employ adductive/productive/appositional thinking and use non-verbal, graphics and spatial modeling media." Hennessey (1994) attempts to identify the basic norms in the evaluation methods of product creativity. Dorst and Nigel (2001) suggest that creativity in the design process can be validly compared to "bursts of development." Christiaans and Venselaar (2005) observe a significant relationship between the level of process knowledge and creativity of the product. Although creativity evaluation is significant in design education, research within the design education domain is inadequate (Demirkan & Afacan, 2011). Hargrove (2007) recognizes a strong relationship between metacognitive thinking and divergent thinking. His research demonstrates that students who participate in educational intervention focusing on using metacognitive thought process to improve creativity compared to students who did not participate.

Many universities encourage students to obtain experiences within different cultural settings during their design program. William Maddux and Adam Galinsky (2009) were the first to identify the relationship between overseas education and heightened creativity. They observed that students who spent time abroad demonstrated higher ability to possess innovative insights. However, like many other studies, their study did not quite establish causality, yet it indicates that influence from other cultures helps enhance students’ creative thinking ability.
This study explores the impact of study abroad experience on the development of creativity in design students. The study examines a study abroad program in The College of Design at North Carolina State University. It compares the creativity aspects of fluency, flexibility, and originality in students who participate in a study abroad program against students who did not partake in the program. Another aspect of this study examines whether a study abroad experience impacts a personality trait linked to an individual's creativity; it also looks for the underlying relationship between study abroad experience, openness to experiences, and creativity. This is an important aspect of investigation since it highlights the reasons for the difference in students' creative abilities among those participating in a study abroad program with exposure to different cultures and those without. Understanding whether and in what ways a study abroad cross-cultural experience enhances creative abilities will aid in managing and supporting a study abroad program in design education.
CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

A literature review is a critical element when conducting a study. It involves an evaluation of previous studies within the subject area. A critical appraisal of accredited sources focusing on the subject forms the main grounds for this section. This literature review is structured around different themes to provide a clear framework of the terms used in this study and the nature of their relationship.

This literature review contains five sections. The first section includes a wide definition of creativity and marks the key points for defining it. The second section presents the evolution of the concept of creativity and its impact on the evolution of creativity definitions. The third part involves the major theories of creativity and concludes with the definition of creativity as used in this research. The fourth section presents various evaluations on creativity and the major tests scholars use to measure creativity. The last section discusses critical components of the proposed research, including the impact of personality and cross-culture exposure.

2.2 The Definition of Creativity

Numerous studies have examined a variety of aspects related to creativity. Creativity is difficult to define. Researchers have used several dimensions to define creativity. Individuals have expressed creativity in various fields including science, education, arts, and business. Scholarly literature typically explains creativity as the process of
producing something new and valuable or novel and appropriate (Pope, 2005). This statement points out two key terms of creativity: originality and appropriateness. Published in 1999, the *Handbook of Creativity* has since played an essential role in prominent academic creativity research. The definition of creativity offered by its editor, Robert Sternberg, is that creativity is the capability to generate something that is innovative (original, unexpected) as well as appropriate (adaptive concerning task constraints). Similar definitions are made by most of the book’s contributors, such as "novelty and value" (Gruber & Wallace); "original and appropriate" (Martindale); "anything new that is important" (Lumsden); and "novel and suitable solutions to problems" (Feist).

The creative thinking process denotes the set of cognitive activities that can result in novel, still appropriate creations in any given problem situation (Lubart, 2000–2001). Fromm (1959) and Brunelle (1970) agree that creativity should be viewed as a process and that creativity is the course in which something novel is created (Gardner, 1988; Smith, Ward, & Finke, 1995). However, researchers also perceive that creativity can be viewed as the attitude a person possesses while attempting to produce something new. Therefore, research maintains that attitude and mentality in themselves can still be considered creativity even if something new or different is not created (Smith et al., 1995).

Researchers enthuse creativity primarily to separate causal cognitive theories and sub-processes that enthuse creative acts and to develop ways to enhance creativity in individuals (Zeng, 2011). Conversely, some researchers and designers view
creativity as a special gift a few individuals possess that cannot be effectively taught (Treffinger, Isaksen, & Dorval, 1994).

In some cases, creativity is also associated with expertise. Some authors believe that people who have made unique and critical contributions in their respective fields are the only individuals who show creativity. This has led to the concept that creativity is only for distinguished individuals who create the ideas that others find difficult to emulate (Gardner, 1988; Smith, Ward, & Finke, 1995). However, some authors disagree with this viewpoint, arguing instead that everyone can express and develop creativity in his or her day-to-day careers. This idea is based on the concept that creativity can be expressed in many ways. To better understand this debate, it is important to take a broad view of the historical changes in the concept of creativity by looking back at earlier explorations (Kaufman & Sternberg, 2010).

2.2.1 A Historical View of Creativity

The Cambridge Handbook of Creativity (1999) describes creativity as follows:

*The concept of creativity has its own history, taking an intellectual path that was for two centuries independent of the institutionalization and conceptualization of research. At their beginnings and during most of their histories of development, research and creativity were not viewed as related to one another. Therefore, if there were to be creativity research, the pairing of creativity and research had to go through several major intellectual transformations, and a deliberate extension in how scientific research was*
defined and could be applied needed to be undertaken. As it was, it took another 150 years after research was a recognized and widely encouraged institutional undertaking before the concept of creativity was sufficiently sculpted out of the many debates regarding the meaning and eventual separation of such competing ideas as imagination, originality, genius, talent, freedom, and individuality.

The Biblical story of creation, found in Genesis, is the earliest expression of the Western notion of creativity. It describes artisans’ performance of God’s work on earth (Boorstin, 1992; Nahm 1957). This belief reveals a marked dissimilarity between Western and Eastern thinking regarding creativity’s purpose and the role participants play in the process. Hindus (1500–900 BC), Confucius (c. 551–479 BC), Taoists, and Buddhists view creation as a kind of utmost discovery or mimicry. Early Buddhists emphasized natural cycles, and thus “the idea that the creation comes from something ex nihilo (from nothing) did not exist in a universe of the yin and yang” (Boorstin, 1992).

Several further intellectual developments took place before the concept of creativity fully developed. The most significant distinctions arose in the mid- to late-1700s, when the concept of creativity was distinguished from genius, originality, talent, and formal education. It was established that even though individuals demonstrate skill in a particular field as a response to their education, a real genius is certainly exceptional, and the regulations, customs, and responsibilities that apply to the skilled do not apply to such geniuses (Addison, 1711/1983). Kaufman (1926) and
Engell (1981) clarify that these persistent disputes about the associations and differences between genius, originality, exceptionality, innate ability, and freedom ultimately merged within the 18th-century individualism doctrine (with the American and French Revolutions both about to occur). However, there was still no concept of creativity at that time.

After reviewing the 19th-century research, Becker (1995) concludes that the 19th-century themes are the same as those of the 20th century, irrespective of the dissimilarities in the authors’ and articles’ features. Early in 1827, Bethune was interested in the ability to generate new blends of thought, and he believed that creative genius could preserve ideas for imminent blends (Becker, 1995). According to Becker (1995), Bethune foresaw some of Freud’s thoughts, arguing that those future combinations would be sensible only when the chain of connection is redeemed. Becker also quotes Jevons (1877), who defined genius as essentially creative and who foresaw many ideas later used in Guilford’s (1968) differentiation between convergent and divergent thought process. For instance, Jevons defined genius as “a divergence from the ordinary grooves of thought and action” (Becker, 1995) and continued to describe a process that clearly resembles a variety of associative theories of creativity (Mednick, 1962).

By the 1900s, measuring individual differences in intelligence had become a research interest for several psychologists. By 1904, Binet and Spearman started their empirical investigations on intelligence tests with Binet’s test. These investigations were comprised of items he presumed required imagination and what
is currently known as divergent thinking (Brody, 1992; Willerman, 1986). Terman revised the Binet-Simon test. Although he used the IQ test in his research, Galton provided the conceptual framework (Terman, 1924). Terman was the earliest American psychologist who had a research interest in identifying what is essentially genius. His research is important for its methodological challenge as well as its educational and social implications. Guilford (1967) astutely observed Terman’s work and determined its direction toward the ability to scale people along a particular dimension. These methods were relatively simple. Creativity was too complex and mentalistic and thus removed from educational performances. Terman has also been criticized because of what is sometimes perceived as his one-sided focus of IQ on giftedness, excluding creativity and non-academic achievement.

One of the main factors making creativity a subject of study is its differentiation from intelligence (Wallach, 1983). Before the 1950s and 1960s, most research presumed creativity and intelligence mean the same (Gardner, 1988; Smith, Ward, & Finke, 1995). Early research paid attention to whether creativity is dependent on intelligence. Researchers claimed no need to study creativity as an individual subject if it depends on intelligence. However, after conducting primary research, researchers found that creativity does not depend on intelligence (Albert & Runco, 1989; MacKinnon, 1983). This important discovery attracted great attention and increased focus on studying the concept of creativity and its influential factors.

Many studies suggest that creativity should be studied independently, as it in no way depends on traditional intelligence. However, some other authors continue to hold a
contrasting opinion. Getzels and Jackson studied a small group of students in 1962 and determined no correlation between creativity and traditional intelligence. However, Wallach and Kogan severely refuted this viewpoint in 1965 (Treffinger, 1994). They claimed that the previous studies’ assertions and conclusions were not based on comprehensive and carefully conducted primary research. They questioned their predecessors’ methodology and stated that the testing environment was inappropriate. Therefore, their study employed different methods, including open-ended questionnaires, from which they determined that creativity be independent of intelligence.

It has taken a host of writers, philosophers, and artists even to come close to a concept of creativity, proving the difficulty in developing such a concept. Because creativity relates to individuals, many including Galton researched *Heredity Genius* (Galton, 1869, 1962). The London school of differential movement pursued an explanation of the fundamental constituent of creative thought production (Hargreaves, 1927). The foundation pertaining to the scientific exploration of creativity in the field of specific capability variations has resulted in the theory that creativity is principally an intellectual trait. Significant studies build upon those conducted by Terman and associates (Terman & Oden, 1947, 1959), Guilford (1950), and Torrance (1974). Moreover, the focus on intellectual traits during creativity research may have diverted the attention from other noteworthy individual variation traits, such as personality, motivation, values, and interests. A later review
inspects the association among creativity, intelligence, and personality (Batey & Furnham, 2006).

Kaufman and Sternberg (2010) point out that "most creativity researches do not include a clear definition which partially accounts for the frequently conflicting research on the topic." Defining creativity is daunting since it cannot be scientifically conceptualized. Authors who sought to define creativity based on the scientific approach have ended up providing ambiguous definitions. This does little to harmonize the actual definition. Most authors believe creativity is the ability of an individual to create something ‘new’ or ‘different,’ while other studies assert that creativity is about creating something ‘novel’ (Horn & Salvendy, 2006). In this context, ‘novel’ implies something that is original and unexpected, is of high levels of quality, and is of great use in the specific context of production (Sternberg et al., 2005).

2.3 Theories of Creativity

The objective of this section is to develop a relative assessment of the primary theories of creativity. The section is presented in two parts: The first part explains how the theories are categorized and compared, emphasizes the key challenges, and presents the considerations and limitations. The second part summarizes different categories of current creativity theories; emphasizes the causal assertions, key concepts, and significant findings; and presents contemporary prototypes of these categories.
2.3.1 Categories of Creative Magnitude

The components of comparison should be in place during a review of diverse and complicated subjects like creativity theories. In *The Cambridge Handbook of Creativity*, researchers built a system to classify different creativity theories. Their different categories and elements of comparison demonstrate the similarities and distinctions across the varied group of primary creativity theories and result in a comprehensive overview of the theoretical landscape of creativity studies.

Every classification system has its limitations, and not all creativity theories are alike. Creativity encompasses multiple definitions, conceptualizations, domains, disciplines that bear on its study, empirical methods, and levels of analysis, all of which only emphasize its dissimilarities in classification. Two fundamental theories relate to creativity: scientific theories and metaphorical theories. Kozeblt, Beghetto, and Runco (2010) define these two types of theories: "We define scientifically oriented theories as having an underlying goal of mapping the empirical reality of creative phenomena. In contrast, more metaphorically oriented theories attempt to provide alternative representations of creative phenomena." Scientifically-oriented theories often use metaphors to illustrate key principles (e.g., the mind as a processor of information), and metaphorically-oriented theories are also used in rigorous empirical studies.

Scientifically-oriented theories seek to encounter traditional scientific standards such as objective facts, empirically alterable hypotheses, and formal or computational
models like the harder sciences. In this way, scientifically-oriented theories offer an empirically exact map of reality, frequently with the hope that they would develop into larger theories with vast usage. Metaphorically-oriented theories provide a better abstract standpoint on phenomena and concentrate on provoking new considerations and prospects. In other words, metaphorically-oriented theories deliver a regulating offset to the occasionally blatant empirical focus of scientific theories.

**Creative Magnitude (Big-C, Little-c, Mini-c, and Pro-c)**

When comparing different theories of creativity, it is imperative to distinguish between the amounts of creative magnitude, or little c (often more subjective) versus Big C (more objective) Creativity (Csikszentmihalyi, 1996, 1998; Stein, 1953). These different levels allow us to have a better interpretation of the scope, nature, and boundaries of theories under consideration. The best of the general differentiation is the Big C (eminent)/little-c (everyday) dichotomy. Big-C Creativity is about the clear-cut instances of creative expression; for example, Kozbelt and Runco stated “Dickinson’s poetry, Coltrane’s jazz, Freud’s psychology” can be considered Big-C (2010). However, little-c creativity is all about the creativity of day-to-day life (Richards, 2007), the experiences and expressions that almost anybody can access, such as a home chef mixing the ingredients of a recipe in a different way and the result being appreciated by family and friends. However, these categories may not have as much nuance as other dichotomies. These categories can also be too complete in certain situations and not so complete in others. For example, a less
prominent artist who makes her living selling watercolor paintings and teaching water coloring at the local community college can be compared to a weekend watercolorist who paints during his leisure time and gives away his paintings to friends. Compare these examples to an elementary school student who loves to create paintings with watercolor, gaining more insight about how to merge shapes, shades, textures, and colors with each painting. Though each of these instances shows qualitatively different levels of creativity, none of these can be termed as Big-C Creativity.

Kaufman and Beghetto (2009) developed two more groupings (mini-c and Pro-c) to address the drawbacks of the conventional dichotomy. The mini-c category aids in distinguishing between the subjective and objective forms of little-c creativity (Beghetto & Kaufman, 2007), creating space for the more subjective or personal (Runco, 1996, 2004), internal (Stein, 1953), or mental or emotional (Vygotsky, 1967/2004) forms of creativity. The Pro-c category aids in identifying the grey area between the little-c and Big-C Creativity. Pro-c creativity creates space for professional-level creators (like professional artists) who are not yet prominent and may never be, but are much ahead of the little-c creators in knowledge, motivation, and performance. These four categories can highlight likenesses and distinctions in the focus and scope of theories.
The Six Ps of Creativity

Aside from the ‘new’ and ‘useful’ concept and the long history of creativity, other important elements, otherwise called aspects, should be considered when defining creativity (Rhodes, 1961; Runco, 2004). These aspects are conventionally called the ‘four Ps of creativity’ and include process, product, person (or personality), and place (or press). Some of the latest versions of this framework (Runco, 2007) have enhanced it to six P’s after including persuasion (Simonton, 1990) and potential (Runco, 2003).

**Process** theories typically identify the various phases of processing (e.g., Mace & Ward, 2002; Simonton, 1984; Wallas, 1926; Ward, Smith & Finke, 1999) or specific mechanisms as the constituents of creative thought (e.g., Mumford et al., 1997; Mumford et al., 1991). The objective of theories that emphasize the creative process is to interpret the characteristics of the mental mechanisms that happen when someone is involved in creative thinking or creative activity.

**Product** is the most objective approach in creativity, and it includes tasks related to art, inventions, publications, and musical compositions. Products have two substantial advantages: they can typically be counted and therefore allow substantial quantitative objectivity. They can be inspected and judged most of the time, making it easy to determine the inter-rater reliability (Sternberg, 1999).

**Person** or personality earns the most attention during creativity research. Earlier research linked the traits of mathematicians, architects, writers, and other groups to
determine if they are indicative or contraindicative of their creative potential. Many traits like intrinsic motivation, wide interests, openness to experience, and autonomy are prevalent across different domains (Barron, 1995; Helson, 1972). Some personality traits appear to be more ubiquitous in both artists and scientists (Feist, 1998, 1999). Personality is currently considered just one influence on creative behavior and not a whole factor (Feist & Barron, 2003).

**Place** or press (from pressures) constitutes environmental factors. An individual's resident setting or climate influences the expression of personality. Researching place helps in understanding such communication between persons and environments. Opinions differ on which environment is preferred; however, creativity apparently flourishes when the situation presents opportunities for individuality, exploration, and independence and when ingenuity is esteemed and appreciated (Amabile, 1990; Witt & Boerkem, 1989).

Simonton's (1990) perspective states that "creative people change the way others think, so they must then be persuasive [emphasis added] to be recognized as creative." The perception of creativity as persuasion holds similar assumptions to those of the social perspective (Amabile, 1990), the attribution theory of creativity (Kasof, 1995), and Csikszentmihalyi's (1988a) systems model. The importance of persuasion suggests that everyday originality (Runco & Richards, 1998) is mostly personal and may not be considered creative.
Runco (2008) mentions that structuring the creativity definition further can result in a hierarchy that begins with theories of creative *performances* versus creative *potentials*. Performance is categorized into products and persuasion theories, as well as any other standpoint emphasizing noticeably clear creative behavior. Potential is categorized into creative personality and places, along with any other standpoint valuing yet-unfulfilled prospects and subjective processes.

The six Ps approach has garnered a comparatively vast consensus (Runco, 2004). The way researchers construe this new and suitable definition of creativity will determine their assessment of the construct. As Batey (2012) stated:

> ... *if usefulness is taken to mean utility for society as a whole, then how creativity is measured and what populations may be sampled is very different from the researcher who sees usefulness as relating only to the experiment or study at hand. Those researchers who emphasize the importance of social appraisal or ecologically valid appraisals of the novelty and utility of a creative person or product will be inclined to measure the construct using raters or judges.*

People who endorse a person-centered approach to creativity tend to assess creativity using trait attributes such as intelligence or personality (Eysenck, 1993; Guilford, 1950). On the other hand, people who insist on a process-centered approach may associate creativity with problem-solving (Finke, 1992; Mednick, 1962). Others may concentrate on the climate for creativity if they insist on the role
of environment (Amabile, 1996; Dul & Ceylan, 2011). That said, the most overriding definition is the new and useful product-oriented view that states, "Over the course of the last decade, however, we seem to have reached a general agreement that creativity involves the production of novel, useful products" (Mumford, 2003). This implies that individuals who endorse this view define creativity based on outputs or products, which in turn means that the individual who created the novel and useful product is creative.

The six Ps approach denotes that there are varied assessments of creativity available. It integrates an assessment of the product along with the features of the person, press, and practices necessary for creativity. Hence, it may be hypothesized that all these approaches have pointed to multi-componential models and thus evaluations of creativity that includes a person, process, product, and press along with the significance of social appraisal.

2.3.2 Classifying and Comparing Theories

The long history of creativity research has produced many different theories. Sternberg summarized the major creativity theories discussed in the literature throughout the past several decades (Table 2.1).
Table 2.1 Creativity Theories (Sternberg, 1999)

<table>
<thead>
<tr>
<th>Category</th>
<th>Primary Assertion</th>
<th>Key Concepts</th>
<th>Six P’s Focus</th>
<th>Levels of Magnitude</th>
<th>Major Studies and Examples</th>
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</thead>
</table>
| Developmental                   | Creativity develops over time (from potential to achievement); mediated by an interaction of person and environment. | Place and family structures  
Role of play  
Support during transitions  
Longitudinal process  
Multivariate influence | Person, Place, Potential, & Product | Mini-c to Pro-c | Nelso (1999)  
Subotnik & Arnold (1996)  
Albert & Runco (1989) |
| Psychometric                    | Creativity can be measured reliability and validly; differentiating it from related constructs (IQ) and highlighting its domain-specific nature. | Reliable and valid measurement  
Discriminate validity  
Thresholds  
Domain specificity | Primarily Product | Little-c to Big-C | Guilford (1968)  
Wallach & Kogan (1965) |
| Economic                        | Creative ideation and behavior is influenced by “market forces” and cost-benefit analyses. | Influence of macro-level factors  
Psycho economic perspective  
Markets of creativity  
Investment decisions | Person, Place, Product, & Persuasion | Little-c to Big-C | Rubenson & Runco (1992, 1995)  
Florida (2002)  
Sternberg & Lubart (1992, 1995) |
| Stage & Componential Process    | Creative expression proceeds through a series of stages or components; the process can have linear and recursive elements. | Preparation stages  
Incubation and insight  
Verification and evaluation  
Component mechanisms | Primarily Process | Mini-c to Big-C | Wallas (1926)  
Runco & Chond (1995)  
Amabile (1999) |
| Cognitive                       | Ideational thought processes are foundational to creative persons and accomplishments. | Remote association  
Divergent/convergent thinking  
Conceptual combination, expansion  
Metaphorical thinking, imagery  
Metacognitive processes | Person & Process | Little-c to Big-C | Mednick (1962)  
Guilford (1968)  
Finke, Ward, & Smith (1992) |
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<tr>
<td>Typological</td>
<td>Creators vary along key individual differences, which are related to both macro- and micro-level factors and can be classified via typologies.</td>
<td>Individual differences Categories of creators Seekers versus finders Integrate multiple levels of analysis</td>
<td>Primarily Person; but also Process, Product, &amp; Place.</td>
<td>Little-c to Big-C</td>
<td>Galenson (2001, 2006) Kozbelt (2008)</td>
</tr>
</tbody>
</table>
Based on the chart above, there are ten major creativity theories. Developmental theories, Psychometric theories, Economic, Stage and Componential Process, Cognitive theories, Problem Solving and Expertise-Based theories, Problem Finding theories, Evolutionary theories, and Typological theories, Systems. This research focuses on the impact of environmental changes on creativity. Most researchers focus particularly on creativity in design, which is ill-defined problem-solving. This research uses some psychometric methods to measure creativity. To achieve this objective, four creativity theories are discussed in detail, including developmental theories, psychometric theories, cognitive theories, and problem-solving and expertise-based theories. These four theories can build a good base for creative research in human cognitional and behavioral environmental research areas.

**Developmental theories** of creativity are the most pragmatic. They are useful in comprehending the origins of creativity, and they provide insights on designing environments to realize children’s creative possibilities. Developmental theories principally concentrate on the person, place, and potential characteristics of creativity, scaling from mini-c to Pro-c.

Previous developmental theories are based on a study of the lives and family circumstances of renowned creative individuals (Goertzel & Goertzel, 1976). These theories indicate that certain developmental experiences are associated with creativity. For example, the parents of these creative individuals provided their children exposure to a multitude of experiences and in some cases, they themselves were creative. It was observed that these families provided a reasonable level of
independence (Albert & Runco, 1989). Parents knew well the actions of their children and limited their children very little. Autonomy develops in children who have reasonable independence, and such children can think and develop new and original concepts. Many studies on development have included family structure as a critical component. Social and behavioral scientists have been eager to study the family structure (e.g., birth order, ordinal position within the family, age gap between siblings). Galton (1869) identifies that firstborn children have a relatively substantial developmental advantage, and therefore are mostly successful. Galton did not study creativity particularly, but instead concentrated on people with more traditional accomplishments.

Some research related to developmental theories focuses on play and creativity (Ayman-Nolley, 1999; Pearson, Russ, & Cain Spannagel, 2008; Russ & Schafer, 2006). This research area interprets the supportive role of nurture and environment in creative efforts (e.g., accommodating environments enable exploration and imaginative play) and as such, the theories of creative development (e.g., creative ideas are the output of relaxation and enjoyment from play).

Longitudinal study is one of the most powerful and trustworthy developmental ways to perform research in most cases. Conclusions from longitudinal research are beneficial in building theories of creativity, and there are several longitudinal studies in this area (e.g., Albert & Runco, 1999; Helson, 1999; Plucker, 1999; Subotnik & Arnold, 1996). Albert and Runco (1999) used exceptionally gifted boys as a sample for more than 20 years. Their findings reveal that the truly gifted children received
the required intellectual and monetary support during childhood for their cognitive and emotional transitions – either from common to creative skills or from capability to motivational state. Both result in enhanced performance and accomplishment. Such longitudinal studies support creativity theories’ consideration of cognitive processes, motivation, emotional impact, and personality.

**Psychometric theories** do not explain the developmental upbringing of creative people, their thought processes, characters, or motives. Instead, they focus on measurement and therefore highlight ‘product’ over the rest of the Ps. These theories scale from little-c to Big-C Creativity.

Psychometric theories are dependent on the reliability and validity of the assessment, as these measurements are important for scientific investigations on creativity. Reliability refers to uniformity of values and comprises inter-judge reliability and, in a specific test, inter-item reliability. Validity refers to the exactness of the values measured and is usually explained by asking, “Are you measuring what you intend to measure?” One category of validity is criterion-related, which encompasses predictive validity and discriminant validity. Predictive validity is an indication of some criterion of original creative behavior offered by the measure of creativity. Discriminant validity is an indication of the amount to which creativity measure is different from other indices of non-creative talents, like traditional intelligence, IQ, convergent thinking, and so on.
Even though some studies endorse the validity of different creativity tests (Wallach & Kogan, 1965), the actual connection is dependent on the ability level of the individuals taking the test, the testing environment, and the tests offered. The level of ability is considered a threshold theory, as this theory states that IQ and the like are highly linked to creativity indices below a reasonable level of general ability, and that these factors are highly independent above that threshold (Fuchs-Beauchamp, Karnes, & Johnson, 1993; Kim, 2005; Runco & Albert, 1986). The testing environment is significant for educational settings from the standpoint that independent and relaxed environments enable more varied, original thinking compared to standard testing environments. The kind of tests used is also critical in assessing the discriminant validity in terms of convergent and divergent thinking. Guilford (1968) states these concepts in his Structure of Intellect (SOI) Theory. The terms ‘convergent’ and ‘divergent’ production are included in his theory; the theory also indicates that if the test permits more divergent thinking, the test becomes more independent from the measures of convergent thinking. Original, novel, and unique ideas form only when the tests enable divergent thought process.

**Cognitive theories** highlight the creative process by insisting the position of cognitive mechanisms is a foundation for creative thought and person, in the view of individual dissimilarities in such mechanisms. Of the different cognitive theories of creativity, a few emphasize common capabilities, like attention or memory, while others insist on individual variations, like the ones measured by divergent thinking tasks. While some theories focus on conscious operations, other emphasize
preconscious, imbedded, or unintended processes. Some view creativity as a process to solve problems, while others see creativity closely linked to cognitive processes like finding problems that are debatably independent of problem-solving.

One cognitive theory debate argues that associative processes can yield creative insights. Mednick (1962) explains the way different ideas connect; remote associates have the tendency to be original. The ideas may become associated with each other in different ways; for example, they may relate functionally or acoustically. While some people have the tendency to pass swiftly from obvious associates to remote ones, others do not. Individuals who are more creative tend to have flatter hierarchies of associations compared to the less creative ones. In short, individuals who are more creative possess comparatively robust associates for a concept provided (Sternberg, 1999).

Research is being conducted in the "creative cognition approach" (e.g., Finke et al., 1992; Ward et al., 1999). Such research utilizes concepts from cognitive psychology (e.g., conceptual combination, conceptual expansion, creative imagery, and metaphor) in interpreting the way individuals produce ideas and discover their implications in lab-based invention and design tasks. The research operates under two basic regimes of thought: creating ideas and discovering their implications.

Metacognitive processes are mostly linked to creative thinking and are consciously controlled entirely. To quote an example, tactical thinking is metacognitive and many tactics are available for enhancing the possibility of creative problem solving,
including "think backward," "turn the situation upside down," "shift your perspective," "put the problem aside," and "question assumptions." Tactical thinking is specifically valuable for programs meant to enable creative problem solving, as they are a function of conscious decisions and can be utilized when required (Davis, 1999).

**Theories based on problem solving and expertise** are developed from one of the sub-catalogs of cognitive theories. These theories focus on problem-solving methods and expert knowledge (e.g., Ericsson, 1999; Newell, Shaw, & Simon, 1962; Simon, 1981, 1989; Weisberg, 1999, 2006). This standpoint presents a theory of the creative individual by insisting that domain related expertise is important for noteworthy creative accomplishments and the creative process, which demonstrates how conventional cognitive psychological ideas such as problem representation and heuristic search through problem spaces depict the generation of creative solutions to problems. The problem solving/expertise view is like the creative cognition view as it clearly argues that mundane cognitive practices are the root cause for creative thought (Perkins, 1981). Expertise based theories usually concentrate on Big-C Creativity, while the creative cognition view is more focused on little-c creativity.

Problem-solving studies generally employ puzzle problems (Newell & Simon, 1972). However, their principles relate to ill-defined problems related to creativity. Certain 'problems,' like creating a symphony or designing a house, have objectives that are not predefined. They may produce a multitude of 'good' solutions, instead of a single 'right' answer. Simon (1981) debates that not-so-well-defined problems can usually be sub-divided into a group of well-defined problems, and these sub-elements can
be resolved using easier methods. Furthermore, creativity is not just finding a solution for a problem, but also identifying the right methods to articulate the problem (Simon, 1989).

According to this view, Big-C cases of Creativity usually evolve with the solicitation of a domain-specific expert knowledge base obtained through many years of extensive study. Expertise strongly affects performance and cognition in any domain. Experts are good at recalling domain-related patterns and are more proficient in producing efficient problem representations. They are usually involved in effective forward reasoning in problem-solving, not strenuous backward reasoning (Ericsson & Charness, 1994). Whether these advantages can enable performance even in more open-ended, “creative” domains, like art, design, and music composition is debatable (Ericsson, 1999; Kozbelt, 2008). Most processes and structures explained in the creative cognition view directly link to those of the problem-solving/expertise view (Kozbelt & Durmysheva, 2007). Similarly, studying the insight problems at a laboratory has shown the significance of creating suitable problem representations, using heuristics like observing invariant characteristics of unproductive solution efforts and have further clarified some of the cognitive processes resulting in “A-HA!” moments (Kaplan & Simon, 1990; Weisberg & Alba, 1981).

In summary, it has been recommended that the notion of creativity as new and noteworthy applies even to ordinary people. The six Ps approach has already influenced how researchers define and measure the construct.
2.4 Evaluations on Creativity

The evaluation of creativity has a long and wide history like its definition. Numerous studies have attempted to quantify creativity assessment. Each of the analytic tools that have been developed uses a specific approach and focuses on a specific element of the process. This demonstrates that a researcher may face a dilemma while seeking to develop the most appropriate method to assess creativity. The specific element of the creative process on which each study focuses must be contemplated. When people measure creativity, the very first step is to understand what is measured: the creative thinking process or the creative product. Researchers investigating people’s characteristics and cognitive processes have predominantly depended on the psychometric view of creativity studies. Much of the creativity assessment research has used the psychometric tradition, fundamental to the current interpretation of creativity theory (Gardner, 1988; Plucker & Runco, 1998). Research is classified under four major assessments of creativity - divergent thinking and convergent thinking assessments, self-assessment, assessments by others, and consensual assessment. The following section presents a review of each of these assessments and the different tests under the assessments.

2.4.1 Divergent Thinking (DT) and Convergent Thinking (CT) Assessments

Divergent thinking tests are the principal psychometric instruments in the field of creativity testing and are the profound sources used to measure creativity. For example, many of the books written on creativity comprise a lengthy explanation of
DT, and schools generally utilize DT tests to evaluate the creative potential of their students. The notable introduction points for large-scale thoughtful improvement efforts and implementation of DT in assessments include Guilford’s Structure of the Intellect divergent production tests (1967), Wallach and Kogan’s (1965) and Getzels and Jackson’s divergent production tests, and Torrance’s (1974, 2008) Tests of Creative Thinking (TTCT).

Guilford’s (1967) Structure of the Intellect Model (SOI) recognizes different components of divergent thinking, one kind for a combination of the four categories of content (Figural, Symbolic, Semantic, Behavioral) and six types of product (Units, Classes, Relations, Systems, Transformations, Implications). The SOI Divergent Thinking battery contains seven dozen tests, and these tests correspond with the 24 different parts. One Guilford DT task is the Sketches subtest that requires students to sketch as many objects as possible using a fundamental figure like a circle and assesses the figural unit dimension based on their performance. Guilford’s SOI assessments influence several DT tests, including the Torrance Tests of Creative Thinking, among the most vastly used DT assessments.

Guilford (1950) states the primary constituents of creativity are divergent and convergent thinking. Divergent thinking happens when concepts and relations travel in different directions, forming novel and original concepts as a result (Mednick, 1962; Torrance, 1995). However, convergent thinking happens when cognition is the factor used to obtain a single precise or conventional solution. Both divergent and convergent thinking are required in creative efforts resulting in the creation of original
and efficient concepts (Cropley, 2006). Most creativity tests (especially the divergent thinking test) require participants to come up with as many possibilities as they can. Their responses are scored under the categories of fluency, flexibility, originality, and elaboration. Fluency is operationally defined as the number of responses to a stimulus provided, “the total number of ideas given on any one divergent thinking exercise” (Runco, 1999). Originality is operationalized as the exclusivity of responses to a stimulus provided, “the unusualness . . . of an examinee’s or respondent’s ideas” (Runco, 1999). Flexibility is operationalized as the count and/or exclusivity of types of responses to a stimulus provided, or in a broader sense, “a change in the meaning, use, or interpretation of something” (Guilford, 1968). Elaboration is operationalized as the expansion of concepts inside a response type to a provided stimulus, “to fill [ideas] out with details” (Guilford, 1967).

Outputs of studies based on the Guilford/SOI assessments were published in the 1960s. For example, the ‘Instances Test’ asks participants to write down as many things that run on wheels (or that make noise, etc.) as possible (Wallach & Kogan, 1965; Wallach & Wing, 1969). In the ‘Uses Test,’ children respond to prompts such as, “Tell me all the different ways you could use a chair” (Wallach & Kogan, 1965, p. 31) or bricks, pencils, and toothpicks (Getzels & Jackson, 1962). The circumstances under which the participants undertake these tests form the greatest distinction between the different test batteries. Wallach and Kogan (1965) developed untimed divergent thinking tasks similar to games. They believed such format helped measure creativity differently from intelligence, owing to the generation of “a frame of
reference which is relatively free from the coercion of time limits and relatively free from the stress of knowing that one’s behavior is under close evaluation.” Such test methods contradict the timed tests and do not follow the rules of other tests measuring DT. They address concerns such as, “Children are so accustomed to the one correct or best answer that they may be reluctant to think of other possibilities or to build up a pool of ideas to be evaluated later” (Torrance, 1970).

**Guilford’s Test of Divergent Thinking**

Guilford's Test to measure Divergent Thinking is one of the earliest creativity tests. During the early and mid-20th century, most psychologists presumed a link between intelligence quotient (IQ) and creativity (Shaughnessy, 1995). They postulated that individuals are creative if their IQ is high and are less creative otherwise. Creative psychology pioneer J.P. Guilford, on the other hand, had different perspectives. He applied a factor analytic technique to differentiate creative talent from regular skills and accordingly, categorized two different ways of thinking called divergent and convergent thinking, in which creativity is linked with divergent thinking (Shaughnessy, 1995).

In 1967, Guilford developed a creativity test to quantify divergent thinking, called ‘Guilford’s Alternative Uses Task’ (Gundogan, Ari, & Gonen, 2013). This creativity test evaluates individuals’ ability to list the different uses of a common object. Its main goal in determining creativity is originality, fluency, flexibility, and elaboration (Gundogan, Ari, & Gonen, 2013). Originality is measured through a comparison of
others’ test responses in which “Responses that are given by 5% of the group are unusual (1 point), responses that are given by only 1% of the group are unique (2 points)” (Gundogan, Ari, & Gonen, 2013). Fluency is based on how users respond by providing accurate answers, while flexibility is based on the difference in categories. The detail in the responses indicates elaboration. Guilford’s Test of Divergent Thinking is among most effective creativity tests. For that reason, many psychologists and researchers have enhanced its approach to develop more effective creativity tests; one such example is the ‘Torrance Tests of Creative Thinking’ (Runco, 2007).

The Torrance Tests of Creative Thinking

‘The Torrance Tests of Creative Thinking’ (TTCT), postulated by Ellis Paul Torrance, is an approach for measuring creativity. The creativity test was inspired by Guilford’s work and expounds on “Guilford’s Test of Divergent Thinking” (Baer, 2011). During its inception stages, the TTCT focused on measuring the divergent thinking and problem-solving skills of individuals. The approach previously focused on exploring fluency, flexibility, originality, and elaboration as the major scales of creativity, like Guilford’s Test of Divergent Thinking (Baer, 2011). The scales evolved with time and by 1984, the flexibility part was eliminated from the figural test. The exit of flexibility as a measure of creativity within the TTCT signified the inclusion of ‘Resistance to Premature Closure.’ Further changes were made to the TTCT creativity test, including the use of streamlined scoring and new measures including fluency, originality, elaboration, abstractness of titles, and resistance to premature closure.
(Baer, 2011). Even more norm-referenced measures were included with time. Because of the different categories and levels of creativity, there exists various creativity measuring methods (Baer, 2011). Therefore, a test with several measures appears to be more accurate due to its comprehensiveness. TTCT is capable of testing verbal and non-verbal aspects as well as senses, which is quite appropriate because it explores creativity’s different aspects. The use of quantifiable data makes this test as efficient as Guilford’s Test of Divergent Thinking test.

**Remote Associate Test**

The Remote Associates Test (RAT) deals with DT skills despite its difference from conventional DT tests (Mednick, 1968). It follows the associative theory in that “creative thinking . . . consists of forming mutually distant associative elements into new combinations which are useful and meet specified as well as unforeseen requirements” (Mednick, 1968, p. 213). Simply put, persons who are more creative tend to establish more significant and beneficial relationships between disparate conceptions and ideas than individuals who are less creative. Professor Sarnoff Mednick developed the RAT creativity test in 1962 (Shaughnessy, 1995). It consists of about 40 questions and takes an average of 40 minutes to complete. The test questions each involve three common stimuli that appear to be unrelated; the individuals answering the test must determine the similarity among the three stimuli by providing an answer with a fourth word related to the other three (Lee, Huggins, & Therriault, 2014). This approach determines how creative an individual is by
calculating the number of answers they have provided correctly. The simplicity of the approach explains why it is a preferred testing mechanism (Runco, 2007).

2.4.2 Self-Assessment

Self-assessment, in which individuals assess their own creativity, is one of the simplest ways of measuring creativity. This assessment method appears easy and seems too good to be true. Many self-assessment tests measure creativity, with the creative personality assessment and creative behavior checklists among the most commonly used.

Creative Personality Assessment

One of the most common self-assessment methods is the personality inventory. The Five Factor Theory categorizes personality within five constituents: neuroticism (emotional stability), extraversion, openness to experience, conscientiousness, and agreeableness. The component that associates with creativity is openness to experience, whether measured by divergent thinking tests (King, McKee-Walker, & Broyles, 1996; McCrae, 1987), the Consensual Assessment Technique (Wolfradt & Pretz, 2001), or self-assessment measures (Griffin & McDermott, 1998; Soldz & Vaillant, 1999). Instances on this subscale include “I have a big imagination,” and “I spend time reflecting on things” (Costa & McCrae, 1992). The NEO Personality Inventory and briefer NEO Five-Factor Inventory are the most profound evaluations of the five-factor personality theory (Costa & McCrae, 1992). Another assessment method, assessing an individual's creativity style, measures the ways in which
individuals apply their creativity (Selby et al., 1993). The Kirton Adaption-Innovation Inventory (KAI) is one way example (Kirton, 1999). KAI was created to evaluate the personality dimension from adaption (capability to do things better) to innovation (capability to do things differently). Public and private sector organizations frequently apply this 32-item inventory because of its relevance to organizational transformation (Bobic, Davis, & Cunningham, 1999).

**Creative Behavior Checklists**

Another method of creativity self-assessment is the creative behavior checklist, in which individuals can rate their own past or present creative achievements. This method is better than asking individuals questions to determine their personality. The author of *The Creative Behavior Inventory* debates that self-assessments of one’s actions and achievements are the best means to evaluate creativity (Hocevar, 1981). Although the kind of actions and achievements that can be considered creative is ambiguous, the lists utilized in the inventory appear to possess validity considered significant by society (Hocevar, 1981). The inventory’s 90 items assess creative behavior in the fields of literature, music, crafts, art, performing arts, and math/science.

**2.4.3 Parent, Peer, and Teacher Measures: Assessments by Others**

Assessments by others are performed by another person and are based on the creative traits of a creative person such as personality traits, creativity-relevant abilities, motivation and intelligence, thought process styles, and emotional
intelligence and knowledge. This kind of assessment is akin a teacher ranking his/her pupils depending on his/her own knowledge about the students and what he/she believes about a student’s creativity nature. It is also comparable to the Consensual Assessment Technique (CAT) in that another person does the evaluation. However, it differs from the CAT in that the CAT measures individuals’ creative products, whereas assessments by others concentrate holistically on the creative individual. Assessments by others insist on those traits and skills presumed to be applicable to creativity, regardless of the domain. (CAT, conversely, is always specific to domain.) Those who assess with this method have expert knowledge about the individual and are not experts in the field of creativity.

**Creativity Checklists**

Checklists are essential assessment tools in which other people evaluate an individual’s creativity. However, a student’s creativity ratings provided by a teacher or parents using these creativity checklists could result in unintentional bias. The Creativity Checklist by Proctor and Burnett (2004) comprises features that suggest a creative individual, including cognitive as and dispositional traits classified under nine scales: fluent thinker, flexible thinker, original thinker, elaborative thinker, innately motivated student, inquisitive/engrossed in topic, risk taker, imaginative/intuitive, and involves in complex tasks/loves a challenge. These traits are explained in terms of classroom behaviors so teachers can utilize them for elementary students (Proctor & Burnett, 2004). This checklist does not follow any
norms and hence is only suitable for comparing clusters of learners. No criterion-related or predictive validity is proven for this checklist.

**Gifted Rating Scales**

The Gifted Rating Scales (GRS) are user-friendly devices that require marginal training to score and interpret. They are psychometrically dependable and effective, and they come with a standardized sample depicting present U.S. census demographics (Pfeiffer & Jarosewich, 2007). The forms are associated with the Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV) and Wechsler Preschool and Primary Scale of Intelligence-Third Edition (WPPSI-III; Pfeiffer & Jarosewich, 2007). The two types of rating forms are GRS-P for preschool children and GRS-S for school-aged children. The GRS-P consists of 60 items classified under five scales, whereas the GRS-S comprises of six scales of 12 items each, totaling 72 items (Pfeiffer & Jarosewich, 2007). While the forms were meant for teachers to rate their students, research suggests that a Chinese-translated version of the GRS-S enables parents to rate their children (Li, Lee, Pfeiffer, & Petscher, 2008). GRS-S validity is evidenced by comparing to the IQ scores from the WISC-IV. This is effective in determining intellectually gifted students, as intellectually gifted is defined by IQ scores within the top 5% (Pfeiffer & Jarosewich, 2007).

**2.4.4 Consensual Assessment Technique (CAT)**

Divergent thinking is one of the most profound ways to evaluate creativity but certainly not the only option. The combined judgment of top experts in any field
results in the accurate evaluation of creativity (Kaufman, 2009). Unlike the three aforementioned assessments, this assessment highlights the creative product.

The Consensual Assessment Technique (CAT) is such an assessment method. Measuring creative product depends on the notion that a joint evaluation and judgement by specialists in that field accurately measures the creativity of a work of art, concept, or any other product (Amabile, 1996). The subjects create a product and the experts assess the creativity of that product autonomously. Poems, collages, and stories are primarily assessed in CAT studies.

The CAT only provides relative scoring compared to other participants, rather than an absolute score. It is used mostly in research related to creativity and not much in schools. Because there may be wide variations of creativity across different domains or even within the tasks from a single domain (e.g. Baer, 1993), it may not be wise to use CAT ratings to assess creativity from a domain-generic point of view. Schools can effectively use the CAT approach to evaluate students’ creativity for admittance into special programs focusing on individuals excelling in a certain creativity area. Creative writing and visual art are some of the products that typically use CAT, although research now focuses on different fields like music composition (Priest, 2006) and math (Baer, 1994).

The most time-consuming step in this process is gathering the right experts in the field to develop creativity ratings for all products. The experts are not provided instructions on how to rate and therefore use their own inherent definition of
creativity. They are also not permitted to talk about their ratings with each other. Creative products are compared against each other and not to a certain ideal. Current research seeks to identify appropriate levels of expertise required for judging various creative products (Kaufman & Baer, in press). Such studies identify a few guidelines that are valuable in selecting judges. The judges' level of expertise should be sharply higher than that of the subjects (i.e., a published poet or a musician who has performed professionally). The judges must be familiar with the populaces to which the participants belong. Though beginners (such as undergraduates) usually do not agree with each other or with experts (Kaufman, Baer, & Cole, 2009; Kaufman et al., 2008), quasi-experts, like students with special experience or skill in the specific domain, completely agree with experts (Kaufman, Gentile, & Baer, 2005). About five to 10 experts usually are sufficient, but more quasi-experts may be required to increase the inter-rater reliability.

2.5 Creativity and Personality

2.5.1 What is Personality?

Psychologists use the term ‘personality’ to explain the unique and comparatively persistent set of behaviors, feelings, thoughts, and motives that describe a person (Feist & Feist, 2009; Roberts & Mroczek, 2008). This definition includes two prime constituents. First, personality is what differentiates a person from another and makes one unique. Second, personality is largely consistent and persistent. In short,
personality is the comparatively persistent unique ways in which individuals think, feel, and act.

Recent research establishes that several diverse species of animals, from octopus and mice to birds and horses, demonstrate unique and consistently differing styles of behavior (i.e., personalities) (Dingemanse et al., 2002; Gosling & John, 1999; Morris, Gale & Duffy, 2002). This means that personality is not just a characteristic of humans, but also of many mammals, a few birds, reptiles, and fish.

Personal characteristics are an important field of creativity research and much research has shown interest in the stable characteristics of individuals related to creativity. A great deal of research is designed to understand creative personality (Barron & Harrington, 1981). The previous research made certain progress in identifying these characteristics and narrowed down the domain of individuals' creativity. Using achievement and ability as the standard (such as the NEO-PI Five Factor Model) may enable researchers to assess the impact of personality on creativity more accurately.

This research approach seems to be interested in identifying the different types of creative personalities that would prove to be of great importance to recruitment and selection of employees. Perhaps we should not evaluate the potential benefits of identifying creative persons before we have a better understanding about them. Feist (1999) elaborates the significance of this effort and believes that the contemporary world’s main institutions, including politics, entertainment, businesses,
universities, and arts, are all driven by their creativity, which implies that in order to achieve ultimate success and maintain their competitive advantage, they have to develop the ability to employ and maintain individuals with creativity.

### 2.5.2 Historic Connection Between Personality and Creativity

Since 1950, when Guilford made his presidential address, researchers have searched for the shared personality factors of creative individuals, the external factors that influence the individuals’ creativity, and educational factors that relate to the increase of creativity. In early research, many researchers focused on individual factors. During the two decades between 1950 and 1970, the research of IPAR (Institute of Personality Assessment and Research) at the University of California began to focus on finding the factors of individuals that determine “effective functioning” (Barron, 1988). Study participants were creative talents from various areas recommended by professionals in their areas. A few psychologists evaluated the characteristics of these creative individuals for one week. The results of these individuals were compared with those of professionals with less creativity (Sternberg & O'Hara, 1999).

Creativity is often thought to be linked with intelligence; however, according to Barron, intelligence seems to be of little influence on creativity when the IQ of an individual is around 120 (Sternberg & O'Hara, 1999). For people who are eligible for a certain field, it would be more effective to evaluate personality and other factors related to creativity.
According to Barron (1988), creative people share some common traits; “alertness to opportunity,” “keen attention,” and “a drive to find pattern and meaning”. In addition, he points out the qualities creative people should have, including an open mind, intuition, desire for simplicity via complexity, independent judgment, risk taking spirit, and originality to help make odd connections (Barron, 1988). Csikszentmihalyi (1999) argues that individuals who are interested in solving abstract problems tend to be more perseverant. The above-mentioned qualities build the foundation for openness to experience in the Five-Factor model (McCrae, 1993-94). In fact, many researchers have found a certain connection between openness to experience and creativity. Many studies explore the connection between creativity and the Five-Factor model, which could be measured by the NEO Personality Inventory, including openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism (Costa & McCrea, 1992). Research suggests that openness to experience and extraversion have a positive influence on creativity, while neuroticism negatively impacts creativity, which indicates that certain personality factors have a positive influence on individuals’ creativity, other factors have a negative influence on creativity.

2.5.3 Five-Factor Model and NEO-PI

As early as the 1930s, various psychologists, Klages (1926), Baumgarten (1933), and Allport and Odbert (1936), dedicated their efforts to natural language as a source of attributes for a scientific taxonomy. According to their studies of the dictionaries of a natural language, personality vocabulary provides a broad but
limited set of attributes that the people speaking that language in their regular communications have found significant and useful (Goldberg, 1981). Following Baumgarten's (1933) work in German, an innovative lexical research of personality-relevant terms in an unexpurgated English dictionary was conducted by Allport and Odbert (1936). They collected all the terms that could be used to “distinguish the behavior of one human being from that of another” (Allport & Odbert, 1936). Their completed list included nearly 18,000 terms. Because the list was too large for research purposes, Cattell (1943, 1945a, b) began with a subset of 4,500 trait terms. The personality trait category is the major focus of most taxonomic research. Fiske (1949) constructed much simpler descriptions from Cattell's variables; resulting from self-ratings, ratings by peers, and ratings by psychological staff members, the factor structures were highly related and later recognized as the Five Factors. To clarify these factors, Tupes and Christal (1961) re-examined correlation models from eight different samples and found “five relatively strong and recurrent factors and nothing more of any consequence”. These five factors are Extraversion, Neuroticism, Openness to Experience, Conscientiousness, and Agreeableness.

NEO PI is a system aimed to evaluate different personality factors. McCrae and Costa started with the traits of Extraversion (E), Neuroticism (N), and Openness to Experience (O) by factor analysis (Costa & McCrae, 1976). The above-mentioned factors comprised the original version of the inventory put forth in 1978, known as NEO-I. Several years later, McCrae and Costa (1985) developed the measurement of two additional factors, Conscientiousness (C) and Agreeableness (A). Hence,
they added these two factors to the NEO and produced the Five-Factor Model evaluation system and subsequently changed the name of NEO-I to NEO PI (NEO Personality Inventory).

Neuroticism

Neuroticism is a tendency to be consumed by negative emotions such as anger and anxiousness or depression and vulnerability and is related to the stability of one’s emotions as well as their control of impulse. A high degree of stability indicates a stable personality, but individuals of this kind tend to be careless and uninspiring; a low degree of stability usually generates responsive and inspiring personality, but individuals with these merits might be insecure or unstable (Toegel & Barsoux, 2012).

Extraversion

Extraversion refers to the tendency of individuals to be outgoing and stimulating while they are working with others collectively; such individuals are often energetic, positive, assertive, and sociable. Individuals with high extraversion tend to seek attention from others and sometimes are arrogant, while those with low extraversion tend to be more reserved and reflective but sometimes might seem indifferent and isolated (Toegel & Barsoux, 2012).
Openness to Experience

Openness to experience is often related to the willingness of individuals to accept and experience new things such as unusual ideas and adventures (McCrae & John, 1987). A person’s openness reflects their creativity, curiosity, variety, and preference for originality. It also refers to the degree to which an individual is independent or imaginative and whether they prefer to engage in a range of activities to follow a regular routine. Individuals with high openness are often unpredictable or unable to concentrate. In addition, individuals with high openness tend to explore different ways to fulfill themselves, such as living abroad or taking adventures. In contrast, individuals with low openness often fulfill themselves in traditional ways and often tend to be close-minded and dogmatic.

Agreeableness

Agreeableness refers to the tendency to be cooperative and sympathetic instead of skeptical and hostile toward other people. It also concerns whether an individual is easy to get along with and willing to help others. Individuals with high agreeableness are often amiable and easygoing, while those with low agreeableness are often aggressive, difficult to get along with, and perceived as untrustworthy and loquacious (Toegel & Barsoux, 2012).
Conscientiousness

Conscientiousness is the tendency to do everything in a meticulous way, be responsible in work and study, show high self-discipline, and strive to make accomplishments. Individuals with high conscientiousness tend to make good plans for everything in advance, but sometimes they are perceived as stubborn and rigid, while those with low conscientiousness tend to be more flexible but sometimes considered unreliable and cunning (Toegel & Barsoux, 2012).

2.5.4 Openness to Experience

Openness to experience has a strong connection with an individual’s willingness to accept new and unusual things, ideas, and adventures (McCrae & John, 1987). The diversity of experiences in an individual’s field or relevant fields helps expand their knowledge. In addition, experience accumulated from fields that have little relation to an individual’s field could help them develop divergent thoughts and find various solutions to problems. This kind of experience is exactly what open individuals seek, and adapting experiences from other fields into individuals’ own fields would ultimately lead to creative solutions. When individuals pay attention to potential issues instead of existing ones, they are more likely to generate creative products and ideas.

According to Costa & McCrae (1992), openness to experience includes six aspects: openness to aesthetics, openness to fantasy, openness to feelings, openness to values, openness to ideas, and openness to actions.
Openness to Aesthetics

Openness to aesthetics implies sensitivity to and appreciation of beauty, order, and artistic interests (Pace, 2005). Although the application of this term is often limited to artistic endeavors, aesthetic sensibility is applicable to a wide range of fields. Preferences for symmetry and complexity have been observed in highly creative individuals (MacKinnon, 1978). As Tardif and Sternberg (1988) point out, a common strength among creative people is their recognition of worthwhile problems on which to work. This requires awareness of the aesthetic qualities of these problems. This ability is most critical in the research phase.

Openness to Fantasy

Openness to fantasy is the tendency of people to continuously imagine different scenes about the world and potential problems rather than following the routine of everyday life. Feist (1999) lists research that links imagination and fantasy thinking with creativity. Frese (2000) points out the importance of letting employees daydream about new ideas and products during work because it could help foster employee innovation and creativity, thus benefitting the company in the future. Some companies oppose this kind of behavior because it affects short-term company benefits. Openness to fantasy is believed to be positively linked to creativity for jobs that require regular problem-solving.
Openness to Feelings

Openness to feelings is related to individuals’ awareness of their emotions (MacKinnon, 1978). Individuals who are aware of their feelings also value these feelings and attend to the feelings of people around them, which enable them to behave appropriately according to other people’s emotions.

Openness to Values

Openness to values measures the tendency of individuals to embrace different lifestyles and value systems. Individuals with high openness to values often have their own understanding of right and wrong instead of following a traditional value system. Those with low openness to values tend to strictly follow conventions and consider things with fixed values. In this example, a limited relationship between openness to values and creativity at work is found (Pace, 2005).

Openness to Ideas

Openness to ideas is related to an individual’s interest in intellectual and abstract philosophical issues. Individuals with high openness to ideas tend to explore a range of complicated issues and often have special interest in games or puzzles. The Investment Theory of Creativity developed by Sternberg and Lubart (1999) indicates that creative individuals tend to pursue original ideas that have the potential to develop and convince others to believe in the values they follow. Values are of great importance to individuals’ creativity, and according to Walberg (1988), creativity is
the process of searching for workable solutions to problems by combining different factors. Curiosity about new things is crucial to creativity and openness to ideas could greatly influence creativity. Awareness of an interest in new ideas is critical to the creative endeavor.

**Openness to Actions**

Openness to actions refers to the willingness of individuals to explore new things and take action (Pace, 2005). Individuals with high openness to actions tend to experience what they have not experienced before instead of following routines. These people like challenge and love to take adventures. This kind of personality enables them to have different experiences and meet different people, which might help them generate innovative ideas. Hence, it was believed that this aspect would have a certain influence on creativity.

**2.5.5 Relationship between Openness to Experience and Creativity**

Barron and Harrington (1981) listed characteristics creative people share, including good aesthetic taste, diversified interests, attraction to complex issues, high energy, ability to independently make judgment, self-discipline, intuition, ability to adapt to conflicting environments, self-confidence, and the sense that they are creative.

Openness to experience is the most apparent factor in the Five-Factor Model (Costa & McCrae, 1992). McCrae (1987) defines it as “intellectual curiosity, aesthetic sensitivity, liberal values, and emotional differentiation,” and this definition corresponds with Barron and Harrington’s description about creative people. An
individual tends to behave in a creative way when he or she has high openness to experience, which explains why individuals in case studies demonstrating openness are very creative (McCrae, 1993).

According to McCrae (1993), three reasons exist for this relationship. The first is that people with an open mind tend to be attracted to and excel at creative tasks that require problem solving ability. Second, individuals with high openness may possess skills related to divergent thinking and flexible problem solving. Finally, these people are often greatly interested in having all kinds of experiences, which helps them develop creative thinking (Feist, 1999).

Study results have shown that the measures of many aspects of openness to experience are closely linked with the measures of creativity and flexibility in thinking (McCrae, 1987). However, some people began to doubt the reliability of openness’ influence on creativity. Openness to experience was more like a synonym of creativity used to explain the same kinds of features (Martindale, 1989). If that were the case, openness could not be described as a contributing factor to creativity.

Fortunately, McCrae (1987) differentiated openness from creativity by explaining the different roles they play in creative activities. According to McCrae, divergent thinking might display the tendency to be creative, while openness to experience serves as the catalyst of creative behavior. This implies that creativity and openness to experience may interact to yield creative productivity. Creative ability could lead to creative achievement when individuals are open to experience.
Alon with openness to experience, investigations of other traits of creative people indicate that additional factors in the Five-Factor Model also closely relate to creativity. For instance, McCrae, Costa, and Busch (1986) describe people with low extraversion as “emotionally bland” and “over controlled,” while McCrae and Costa (1990) describe people with high extraversion as passionate and active, thus indicating that extraversion has a positive influence on creativity. Barron and Harrington (1981) believe that creative people are often energetic and very confident, and Cropley (1990) points out that people who are willing to risk themselves tend to be creative, which also indicates that extraversion might be positively linked to creativity. Moreover, test results provided by Wolfradt and Predz (2001) show a positive relationship between openness to experience and all creativity measures; they point out that high grades on extraversion are good indicators for an individual’s creativity.

### 2.5.6 Recent Studies on This Topic

In the past 30 years, many researchers have examined the relationship between openness and creativity, and it continues to attract the attention of scholars. Studies investigate the underlying relationship between openness and creativity, and many researchers have tried to apply research results to real life. Dollinger (2004) examines the validity of two different measures of personality and creativity, with results indicating that openness to experience is the critical personality factor related to creativity. Pace (2005) validates the link between openness and creativity in his dissertation and mentions four aspects that are important to creativity: openness to
fantasy, actions, ideas, and values. According to Leung (2008), exposure to multicultural environments tend to indicate better creative potential but only for participants that were open to experience. Hoseinifar (2011) examined the link between the five factors of personality and creativity in high school students and found that except for neurosis, the other four factors of personality are all positively linked with creativity. Kaufman (2013) also explains the connection between openness, experience, and creative accomplishment.

2.6 Cross-culture Impact on Creativity

2.6.1 Definition of Culture and Cross-culture

Lederach (1995) defines culture as “the shared knowledge and schemes created by a set of people for perceiving, interpreting, expressing, and responding to the social realities around them.” Every person belongs to a specific culture and cultural influence is significant to people and society today. However, social interaction exposes people to different cultures. Chiu and Hong (2006) found that "as individuals develop and learn more about their own culture, this knowledge becomes deeply ingrained and automatized, helping individuals make sense of their social environment and coordinate their behavior with others from the same culture with relatively little effort." Individuals learn new skills, behaviors, and languages from the many cultures with which they interact. This transforms their thinking and general perception in relation to different cultural aspects (Maddux, 2010).
According to Ward (1994), knowledge and exposure to different paradigms significantly affect individual behavior and creativity. In a real sense, culture cuts from both edges. From one end, it has a range of routines that may greatly guide social behavior (Chiu & Hong, 2006). However, living in an area that is only exposed to one type of culture may limit an individual's creative options (Leung, 2008). Not everyone who is exposed to another culture can acclimate. Coming face-to-face with another culture and an unacquainted environment can be a nerve-wracking experience (e.g., Gil, Vega, & Dimas, 1994). Individuals may feel astonished by challenging cultural variations and might encounter culture shock (Ward, Bochner, & Furnham, 2001).

Macionis and Gerber (2010) define culture shock as "the personal disorientation a person may feel when experiencing an unfamiliar way of life due to immigration or a visit to a new country, a move between social environments, or simply travel to another type of life." The anxiety and nervousness felt by individuals who engage in a foreign culture can be associated with culture shock. This typically happens when individuals interact with different languages, behavioral norms, food, and even relationships. The assumptions most people take for granted about their culture can have a large impact, as they are inaccessible in the foreign culture (Ward, Bochner, & Furnham, 2001). Although experiencing culture shock presents significant challenges, overcoming the challenges may offer great opportunities to an individual, such as new approaches and perspectives under such circumstances in tackling various tasks and in thinking (Leung et al., 2008).
2.6.2 The Studies on Cross-cultural Impact

Early Studies

With the growing influence of exposure to other cultures in recent decades, researchers are giving more attention to this issue. Historiometric data on creative output of societies over centuries are used to study the effect of societies’ geopolitical situations, and results have shown that societies near cultural centers where cultural exchanges frequently take place usually yield higher creative output (Simonton, 1984). Data also show that societies characterized by political fragmentation (societies comprising of multiple political entities or parties) tend to have higher rates of creativity (Simonton, 1984, 1999). A historical ethnopsychological approach suggests that exposure to multiple sources of power is beneficial, contributing to an expanded world outlook and less conformity.

In addition to studying the effects of exposure to different societies’ geopolitical situations, some studies focus on the potential benefits of bilingualism to creativity, generally using divergent-thinking tests. Languages may have a major impact on people’s thoughts, and exposure to bilingual contexts expands one’s view about the world. Research indicates that bilinguals tend to have higher divergent-thinking performance than monolinguals (Ricciardelli, 1992; Simonton, 2008). In a recent study that used divergent-thinking and a structured imagination test, Kharkhurin (2009) compared Farsi-English bilinguals who live in the United Arab Emirates and Farsi monolinguals who live in Iran. The divergent-thinking test shows that
bilingualism tends to lead to higher originality performance, while the structured imagination task demonstrates a tendency to deviate from standard category properties. In another study, Kharjhurin (2008) compared Russian-English bilingual immigrants with native speakers and found that bilinguals tend to have better performance than monolinguals. The difference varies with the age of bilingual acquisition and time that one is exposed to other cultures.

These studies also illustrate some of the potential complications regarding bilingual populations: Bilinguals may live in a completely different cultural context from that of monolinguals; they may be part of a subculture within a larger cultural context, and they may be immigrants who integrated into a new cultural context. Furthermore, they may be part of a minority group.

Bilingualism is hypothesized to facilitate creativity because of the specific “double coding” of concepts, with each language providing nuances on the same concept. The alternative lexical coding schemes can facilitate associations and conceptual blends. Another facilitating effect of bilingualism is that it enhances mental flexibility, which is important because bilinguals need to shift from one language to another frequently in their daily life.

**Recent Studies**

Some recent studies have focused directly on cross-cultural exposure. Their hypotheses propose that exposure to other cultures contributes to creativity. Such exposure allows people to acquire more knowledge and provides contrasts with
traditional ideas and actions, which help people overcome limitations of their culture. Cross-cultural experiences may also increase the receptiveness of individuals to new cultures. Cross-cultural experiences could offer exposure to new ideas, which might lead to various interpretations of an object, thus shattering traditional knowledge structures and enhancing the possibility of people searching for information through unfamiliar channels (Leung, 2008).

Leung (2008) demonstrates in a series of studies that exposure to multiple cultures can be beneficial to creativity. For example, one experimental study found that people who are exposed to stimuli from two or more cultures can write in a more creative way, while the writing of those who are exposed to stimuli from one culture tends to be rather plain. The same participants, after being tested one week later, demonstrated the continuing influence of cross-cultural experience on creativity.

Another study by Leung (2008) focuses on the influence of cross-cultural factors on creativity. It uncovered the connection between significant cultural experience and creative processing, producing a theoretical argument based on previous literature and offering empirical evidence for further support. This study provides a nice summary of the main theoretical points regarding the benefits of cross-cultural experiences: offering access to new ideas and concepts of different cultures; providing the opportunity to explore the various functions of the same form; changing traditional knowledge structures, enabling people to gain access to knowledge that is generally inaccessible; creating the urgency to incorporate new ideas from different sources; and promoting the combination of original ideas from other cultures.
Chiu (2008) designed a study to use cross-cultural experiences and the openness to experience to predict the performance of European-American undergraduates. The prediction of creative potential is based on two measures: the use of garbage bags and the retrieval of non-prototypical or generally inaccessible instances in the conceptual domain of occupation. Creativity performance consists if both generative practices for active retrieval or generation of ideas and explorative processes for scrutinizing a selective set of candidate ideas. The measures aim to test convergent and divergent thinking performance. The results indicate that those with multicultural experiences tend to perform better on either measure, but this conclusion only applies to students who were open to experience. To the rest who were not open, it seems that a worse performance was obtained when they were exposed to multicultural experiences.

One problem worth noting in creativity theory is the effect of novelty and appropriateness in different cultures. Paletz and Peng (2009) surveyed over 400 students from the United States, Japan, and China. They used textbook products as well as cooking scenarios, and the results indicate that novelty is of great importance to all three countries when it comes to creativity. Nevertheless, disparity exists in the degree to which people from different countries desire the products, and in this study, the effect of novelty on the Chinese was stronger than on the Americans. Appropriateness seemed to play a more important role in the creativity of Japanese and Americans and their desire for products. The researchers were convinced that
cross-cultural research should be conducted instead of simply drawing conclusions from presumptions to gain a better understanding of creativity.

While many studies focus on the impact of short-term cultural exposure on creativity, another group of scholars believe that creativity is only linked to the experience of living abroad. Maddux and Galinsky (2009) made five studies that employed a comprehensive approach and systematically explored the relationship between creativity and living abroad. The first two studies demonstrate that the time one stays abroad (only the time one spends living abroad) is positively linked with creativity. The third study indicates that priming the experience of living abroad tends to temporarily impact creativity. The fourth study shows that the depth of the participants’ adaptation to foreign cultures during their experience of living abroad has a major influence on the relationship between creativity and the experience of living abroad. The fifth study indicates that the creativity of participants who had lived abroad is temporarily enhanced by priming their experience of adapting to the foreign culture. Various studies and research have shown that living abroad has a major influence on creativity.

Another study conducted by Maddux (2010) analyzes the importance of cultural experiences. The results of three experiments found that cultural experiences tend to activate creative and cognitive processing. The research aimed to determine whether multicultural learning in the adaptation process plays a crucial role in enhancing creativity. Several conclusions are drawn from the experiments. First, multicultural experience adds to the flexibility of thinking and enables people to cope
with problems in different ways. Second, it enhances the understanding of underlying associations and connections and overcomes the shortcomings of the fixed function. Additionally, the second and third experiments indicate that learning the meaning or function in people’s behaviors in a multicultural context is of great importance to enhancing creativity. However, the research results also indicate that creativity is only increased when a functional multicultural learning experience is recalled and the participants have living abroad experience. Multicultural learning is an important way by which the living abroad experience leads to enhanced creativity.

Researchers also pay attention to the influence of social networks on the multicultural context of individuals’ creative performance. Chua (2011) examined this influence using network analysis and experimental methods. Different instances were used in the two studies, which found that the heterogeneity of culture in the network positively influence the tasks relative to different cultural knowledge resources. People with a culturally heterogeneous network are more likely to embrace new ideas from other people in the network regardless of their different cultural origins. This result supports the influence of a multicultural network on creativity.

According to Cheng and Leung (2012), individuals’ creative performance is only enhanced when they adopt a different mindset to cope with different cultural stimuli. Studies show that individuals who are exposed to two cultural primes tend to have more creative insight. Measurements of cultural primes, i.e., perceived cultural
distance, are distinct discrepancy measurements of the perceived differences between dual cultures on given physical and social facets.

Discussion

An overview of research on cross-culture and creativity shows that researchers have narrowed down their subjects from societies’ geopolitical situations to languages and eventually to culture itself. Since the early 1980s, researchers have noticed the relationship between creativity and societies’ geopolitics, and they discovered the link between creativity, languages, and related facts in 1990s. Recent research more directly focuses on cross-cultural exposure, thus shifting the focus from the existing phenomenon to external stimulus experiment. Nowadays, researchers are more interested in the links between certain cross-cultural experiences and creativity and exploring the origins of why impacts exist and how to apply them to scientific studies.

Although almost all recent studies are designed to investigate the link between cross-cultural experience and creativity, there are some major differences among them. For instance, Chua (2011) studies the impact of mixed-cultural environments (international social network) on creativity, while Cheng and Leung (2012) focus more on the adaption process to another culture (immigration, change of mind-set). Leung’s study (2008) focuses on the short-term experience, while Maddux (2010) questions the influence of short-term experience and believes creativity would only be increased for long-term living abroad. Leung’s (2008) study concerns the fusion of two or more cultures, while Paletz and Peng (2009) pay more attention to defining
the differences among various cultures. Furthermore, some research examines the continuity of cross-cultural stimuli, such as Leung's experiment (2008), and the function of recall on the continuing influence of stimuli, such as Maddux's (2010) study. In general, the major differences of recent studies can be summarized as mixed-cultural environments and adaption to another culture; short-term experience and long-term living abroad; the fusion of multiple cultures and the comparison among various cultures; and cross-cultural stimuli and stimuli plus recall. All these studies have their own focus aspects of creativity (product, process, person), and they use different methods to evaluate creativity, since the concept of creativity is complex.

After Maddux questioned the durability of short-term cross-cultural exposure's impact on creativity, it seems that long-term cross-cultural exposure may have a more positive impact in facilitating creativity, but there is also a prominent debatable question. Based on the literature, most long-term cross-cultural exposure experiments are designed based on the participants' lifestyles (immigration, mixed-cultural social network), and it is very challenging to change individuals' lifestyles, making it quite difficult to apply those long-term cross-cultural experiences in daily life. Compared to previous studies, this study uses a study abroad program. This experience is neither like the short-term stimulation (movie, travel, etc.) nor like the long-term lifestyle change (immigration, cross-country marriage). It gives participants a reasonable period (one semester) to understand and integrate into another culture and receive education in different cultural environments. The expectation is to detect
what changed and to explore the factors and elements that cause these changes. In this way, researchers may have the opportunity to design a better cross-cultural education program. Specifically, the aim is to explore what kind of experience and activity should be projected and encouraged in design college education study abroad programs.

2.6.3 Critical Factors and Key Elements

Most contemporary research on this topic focuses on investigating a link between cross-culture exposure and creativity, rather than identifying certain factors and elements that change individuals’ creativity. Researchers treat cross-culture exposure as an overall concept; however, a small bit of research explores the factors and elements within cross-cultural experiences. In fact, understanding what factors and elements lead to creativity changes in the contexts of studying/living abroad enhances creativity in an educational way. It helps people understand the nature of the impact and provides insight into designing training programs for students who are studying or living abroad.

From the macroscopic view, many possible elements may affect an individual's creativity in study/living abroad experience. These elements can be divided into two categories: (a) objective elements, such as participants' age, personality and education level, the experience duration, and the level of difference between two cultures; and (b) experience elements, which include certain kinds of unique experiences or activities the participants have in the study/living abroad contexts,
such as keeping diaries or travels, having dinner with a foreign family, shopping in a supermarket, partying in the local bar, celebrating foreign festivals with local friends, or having a lecture in non-native language.

The objective elements are important since they define the questions of "who," "when," and "where" in study/living abroad contexts, but the experience elements are more valuable because they explain the question of "how." Unfortunately, little research exists on experience elements, possibly because: (a) It is quite difficult to control the experience. Research can be designed to encourage participants to perform certain experiences, but they cannot be limited from having other experiences. (b) Experience is a big concept, in which it is very challenging to separate one experience element from another. For example, participants may be invited by a foreign family to celebrate a local festival in a bar, and they may write about that experience in their diary. (c) The design of experience elements usually requires more time, and the results may not show stimulation after the experience. Nevertheless, some researchers keep exploring and trying different ways to capture experience elements.

Maddux and his colleagues found that functional learning in a cross-cultural context is particularly important for enhancing creativity. Functional learning is a proposed model in which subjects will be likely to build continuous relationships between stimuli and responses. He points out that creativity will only be enhanced when functional learning is conducted in a multicultural context (Maddux 2010). His research indicates that creativity is only enhanced when people experience living
abroad and can recall a functional learning experience in other cultures. In the experiment, participants were asked to write down one of their experiences abroad, what they learned about the culture, and the reasons that could explain the phenomenon. According to Maddux's study, recalling cross-cultural experiences plays a crucial role in adapting to other cultures, and cognitive changes that have a major influence on creativity are produced once those changes are overcome.

The results of the above research complements the views of an earlier study about metacognition and creativity. Flavell initially proposed the concept of metacognition in 1976. Metacognition refers to the awareness of individuals of their own cognitive processes. In other words, metacognition is the process of individuals realizing what they are thinking. One approach that could increase creativity is to regard creative thinking as the process of metacognition based on educational programs. Using this approach, students could increase creativity by breaking traditional habits that limit their creative potential (Hargrove, 2007). A consensus is reached on the components of creative thinking processes, indicating that metacognitive skills in evaluation, monitoring, and planning are all part of the processes (Armbruster, 1989). Metacognitive skills are vital to creative thinking applied to solving problems effectively (Jausovec, 1994).

To gain a better understanding and deeper exploration of whether the study abroad experience affects individuals' creativity and explain why such impact exists, this study includes pre- and post- creativity survey data collection as well as a repeated weekly reflection journal to gain better knowledge of the factors that may affect
survey results. Students were asked to write down the most interesting and unusual experience or unexpected activities that occurred each week. The goal of the reflection journal was to understand what kind of experiences challenge the students' standard way of thinking and to provide insight on how foreign study experience affects students' creativity. In this experiment, the weekly reflection journal plays two important roles: (a) as a secondary data source; and (b) as a subsidiary treatment. (The major treatment is the study abroad experience.) Therefore, the journal was required from half of the subjects in both the treatment and control groups. Maddux's design considered the effect of permanent living abroad on creativity, while this research focuses on detecting the impact of a temporary (12 week) study abroad experience on students' creativity. Unlike Maddux's study, which only required a one-time cross-cultural reflection before data collection, this research includes the repeated weekly reflection journals designed to span cross-cultural reflection. Therefore, the results may provide clearer suggestions on linking cross-cultural experience and creativity. Researchers may gain more information about the other factors that cause creativity changes as well as when and how these changes occur in this process.
CHAPTER 3. RESEARCH QUESTIONS AND HYPOTHESIS

The primary research question for this study is as follows:

*Does a study abroad experience in design education impact a student's creative thinking ability?*

This study elaborates on sub-questions based on existing research. Several scholars have found that cross-cultural experience may affect an individual's creative behaviors (Chiu, 2008; Cheng, & Leung, 2012; Leung, 2008; Paletz & Peng, 2009). In this study, participants were asked to provide their previous cross-cultural background; with this information, the researcher explored the following questions:

- *How do specific indicators of creative ability differ among students with different cross-cultural backgrounds?*

- *How does openness to experience differ among students with different cross-cultural backgrounds?*

Some research focuses on the relationship between creativity and personality, particularly openness to experience, with the view that openness to experience is a critical personality factor related to creativity. (Dollinger, 2004; Kaufman, 2013; Leung, 2008, Pace, 2005). Other research focuses on the relationships inside creativity. Existing research shows individuals with high fluency scores also have high originality scores on the Similarities Test (Hargrove, 2007). This study
continues to question the relationship between openness and creativity and the relationship in different parts of creativity:

- How do specific indicators of creative ability (fluency, flexibility, and originality) correlate with each other?

- How do specific indicators of creative ability correlate with individuals' ‘openness to experience,’ as measured by NEO PI?

The study also explores the following questions:

- What is the potential experience that impacts student's creative thinking ability?

**Hypothesis:** Design students who have a study abroad experience as a part of their academic career demonstrate more improvement in indicators of creative ability than design students who do not have a study abroad experience.
CHAPTER 4. RESEARCH METHOD

4.1 Research Design Overview

This study used an experimental research design to investigate the impact of a study abroad experience on student creativity. Treatments (IV) included study abroad experiences and journal reflections, and the creative thinking abilities measured by the Similarities Test and Remote Associates Test (DV) were outputs. The study was designed to had three experimental groups and a control group (Table 4.1).

Experimental Groups 1 and 2 included students who participated in the study abroad program, while Experimental Group 3 and the Control Group consisted of students who remained in the United States. Data collection for all groups began with a pre-test and ended with a post-test survey. Experimental Groups 1 and 3 maintained weekly reflection journals throughout the experiment.

Table 4. 1 Experimental Research Design (Proposed)

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<tr>
<th>GROUP</th>
<th>PRETEST</th>
<th>TREATMENT</th>
<th>POSTTEST</th>
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<td>Study Abroad</td>
<td>Reflection Journal</td>
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<tr>
<td>Experimental Group 2</td>
<td>O</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Experimental Group 3</td>
<td>O</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Control Group</td>
<td>O</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.2 Sample and Sampling

The NC State Prague Institute, an initiative of the North Carolina State University College of Design, served as the study site. There were six sections of the Study Abroad Program: Fall 2014, Spring 2014, Summer 2014, Fall 2015, Summer 2015, and Spring 2016. Most participants were undergraduate students in design-related majors at the university. In Fall 2014, 56 students studied at the Prague Institute. The researcher randomly divided the 56 participants into Experimental Group 1 (28) and Experimental Group 2 (28). The same strategy was also used for the Spring 2014, Summer 2014, Fall 2015, Summer 2015, and Spring 2016 groups. Another 107 students were selected based on their major, age, and academic level (first-year, second-year, etc.) from the population studying in the College of Design during Fall 2015 and Spring 2016. These 107 students were assigned to Experimental Group 3 and Control Group based on their major, age, and academic level. Table 4.2 shows a breakdown of students in each group. Since the number of participants in Experimental Group 3 is too small to be validated, that group was not analyzed as an individual group. By adding up all the Experimental Group 1 and Experimental Group 2, new updated research design and sample can be found in Table 4.3.
Table 4. 2 Sample and Sample Numbers

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</tr>
<tr>
<td></td>
<td>Experimental Group C2</td>
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</tr>
<tr>
<td>FALL 2015</td>
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<td>14</td>
</tr>
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<td>SUMMER 2016</td>
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<td>54</td>
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</table>

Table 4. 3 Updated Research Design and Sample

<table>
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<th>TREATMENT</th>
<th>POSTTEST</th>
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<td>Reflection Journal</td>
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</tr>
<tr>
<td>Control Group</td>
<td>n=48</td>
<td>O</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
4.3 Data Collection Methods

Students were asked to participate in the research study during the study abroad program orientation. The three phases of the study included a computer-based pre-test survey, reflection journal writing, and a computer-based post-test survey. To encourage participation, students who finished both surveys and the reflection journals (only if they belonged to Experimental Groups 1 and 3) had a chance to win a $40 Amazon gift card.

4.3.1 Survey

A survey method resulting in two correlated surveys was used to collect quantitative data. The first survey (pre-test) was completed before students departed to their study abroad destination or upon their arrival at the Prague Institute. Students taking this survey first checked a box to agree to participation in the study and acknowledged confidential treatment of the data solely for the purposes of this study. Students received the survey link from Qualtrics in an e-mail immediately after orientation; they had one week to complete the survey. A make-up session was arranged at the beginning of the study abroad semester for students who did not have the chance to complete the pre-test survey after orientation. The other survey (post-test) was completed before the end of the study abroad semester. Students received the survey via e-mail one week before the final day of class; they had one week to complete the survey.
Both tests were computer-based and included the same number of questions. The pre-and post-test surveys included four sections: basic student information (name, age, major, cross-cultural experience, etc.), 10 Similarities Test questions (Wallach & Kogan, 1965), and 50 Remote Associates Test (RAT) questions (Mednick 1962) and a set of the NEO-PI openness questions (Costa & McCrae, 1992). All groups completed the surveys at the certain time and in a similar environment. To increase the sample size, participants were offered several time options to complete the survey.

**Scoring the Tests**

The scoring of the tests is a critical part of this study. As mentioned above, these three tests evaluate three different aspects of creativity, the Similarities Test is measuring divergent thinking skills, the Remote Associates Test (RAT) is measuring convergent thinking, and the NEO-PI openness test is measuring the personal openness to experience level. Therefore, different scoring strategies were applied to these three tests.

**Similarities Test** - the scoring of the divergent thinking can be divided into four components: the fluency, flexibility, originality, and elaboration. Among them, the fluency and flexibility measure how broad a person can think. The fluency score can get by adding up all the responses from one participant, and the flexibility score is to count how many different categories a participant mentioned in on the answer to one question. The elaboration shows how deep and detail a person can think; this score
can be evaluated by the amount of details from one’s answers. In this particular study, researchers used a 5-point Likert scale ranging from no detail at all (1 point), partially with some details, partially not (2 points), all have some details (3 points), partially with many details, partially not (4 points), all of the details (5 points). The originality indicates how unique a person can think. This score needs to be calculated through all the participants, “Responses that are given by 5% of the group are unusual (1 point), responses that are given by only 1% of the group are unique (2 points)” (Gundogan, Ari, & Gonen, 2013).

**Remote Associates Test (RAT)** - the scoring of the convergent thinking is much more simple and straight. Each of the remote associate test questions has the only right answer. Participants got 1 point if they answered correctly and 0 points for the incorrect ones. Adding all the correct one together is the RAT score of each individual.

**NEO-PI openness** - the scoring of the personality is a tricky job. The NEO-PI test is designed on a 5-point Likert scale ranging: strongly disagree (1 point), disagree (2 points), neither agree nor disagree (3 points), agree (4 points), strongly agree (5 points). However, there are two different kinds of statement in the prompt questions, openminded-directed and closeminded-directed. For example, an openminded-directed prompt is "I believe that the different ideas of right and wrong that people in other societies have may be valid for them." vs. a closeminded-directed "Our ideas of right and wrong may not be right for everyone in the world." All the grading scales from the closeminded-directed prompt were reversed. Adding all the points together
is an individual's openness score. Data on the reliability and validity of the instrument can be found in the Manual (Costa & McCrae, 1992).

4.3.2 Journal

Other sources of secondary data were used to gain better knowledge about factors that may affect the survey results. A weekly reflection journal was collected as qualitative data from half the participants (Experimental Group 1 and Experimental Group 3). During the experiment process. The researcher asked students to write down the most interesting and unusual experience or unexpected activities happening every week. The goal of the reflection journal was to understand what kind of experiences challenge the students' normal way of thinking and to provide more insight into how the study abroad experience impacts students' creativity. The reflection journal may be considered a treatment, since writing the experience requires a series of thinking skills and provides a new understanding of the existing condition.

Each group submitted 12 journal entries per student. Qualtrics (an online survey software) collected the reflection journals. Students received an email containing the journal link every Monday at 9 a.m. local time, and they were instructed to finish the journal in five days, by each Friday at 11:59 p.m. local time.
CHAPTER 5. DATA ANALYSIS

In statistics, a sample, which is a representative subset of the entire dataset, is relied upon to draw conclusions on the entire set. This entire set or the larger set of data is referred to as the population, from which the sample is inferred. Inferential statistics is a mathematical procedure utilized in converting information of the sample into intelligent deductions of the entire population. The main aim is to simplify data about the population or large sample. The present study makes deductions about undergraduate design students. The specific procedures used to make inferences of an unknown population or an unknown score may differ depending on the type of data used and the purpose of making such inferences. Under inferential procedures, the main categories include t-tests, correlations, and regression analyses.

In the current study, several variables were examined using different statistical procedures. Key among the statistical inferential procedures used herein was determination of whether students participating in the NC State Prague Study Abroad Program exhibit higher creativity and openness attributes compared to other students who did not become involved in the program, and whether the improvement of the NC State Prague Study Abroad Program on students' creativity is significant or insignificant.
5.1 Analysis Method

There are two different treatments in this research, the first one is the study abroad experience, and the second one is the journal writing experience. The analysis of these two treatments will be done separately. Both of them used t-test as the major analysis method, and for the journal writing analysis, coding and words frequency were used as a supplemental method to explore the reason why and how does the study abroad experience cause a change in students' creativity. Also, a correlation was done to test the relationship among different aspects of creativity.

5.1.1 T-test

A t-test is a statistical hypothesis test wherein the test statistic goes along with a t-distribution in the null hypothesis. This test can be utilized in determining whether two groups of data significantly vary from each other (Boneau, 1960). For comparing these two groups, the t-test statistical formula includes the means, standard deviations, and a number of subjects for each group. Both sets of data may be derived by use of descriptive statistics. As stated, the t-test is a functional technique used to compare mean values of two different sets of numbers. With such comparisons, it is possible to provide a statistic for evaluation if the differences between two means are statistically significant. Accordingly, t-tests are also utilized for comparing two independent groups (independent-samples t-test) as well as for comparing observations made from two measurement occurrences for similar groups (paired-samples t-test). The paired t-tests are mainly intended to adopt
dependence between samples and are generally used in before/after (pre-and post-test) studies. Whereas both the t-tests compare mean values of two sets of numbers, they are also devised for specific diverse situations.

The independent-sample t-test is used for comparing two groups' scores on the same variable. For instance, it might be used to compare pre-test scores or post-test scores of students participating in the NC State Prague Study Abroad Program as well as for comparing students not participating in the program to evaluate whether there is a significant difference in their pre-test scores or post-test scores.

The paired-sample t-test is also used to compare the means of two variables within a single group. For instance, it can be applied to determining whether there is a significant difference between pre-test scores and post-test scores of students in either the control (not studying abroad) or treatment (studying abroad) groups.

For the current study, the variables used for the t-tests are the scores of students who participated in the NC State Prague Study Abroad Program together with the scores of students who did not participate in the program (or the journal writing group vs. the non-journal writing group). The mean values of these scores establish the statistical significance. These scores are the numerical components of the creativity test given to the students (convergent thinking measured using the Remote Associates Test, divergent thinking - fluency, flexibility, originality, and elaboration measured using the Similarities Test) and scores on the NEO-PI. This comparison revealed a statistic to determine whether the difference between the two means was
statistically significant. Two types of t-tests were employed to compare groups (Figure 5.1). An independent-sample t-test was used to compare the two groups’ scores on the same variable. A paired-sample t-test was further applied in comparing the mean difference of the values to zero within groups.

![Figure 5.1 Independent-sample vs. Paired-sample t-test](image)

To answer the research question, does a study abroad experience impact a student’s creative thinking ability and openness skills, analyses proceeded in three stages. First, an independent-sample t-test was applied to confirm any differences between the treatment group and the control group at the pre-test, which examines if the treatment group and the control group shared the same baseline at the beginning of this study. An independent-sample t-test was used to compare the treatment group and the control group at the post-test, with the intent of observing if the treatment and control groups remain the same at the end of the study. The second step was developing the two individual paired-sample t-tests for the treatment and control groups to specify whether the treatment makes any difference
during the study abroad period. The third step was calculating the differences between the pre-test and post-test and making an independent-sample t-test between the differences of treatment group as well as the control group to examine whether the treatment (study abroad) makes a significant difference. The same procedure was applied in examining whether the weekly reflection journal had any impact on the student’s creative thinking ability and openness skills during the study abroad period.

Before the t-test analyses, researchers need to ensure that all test populations are normally distributed. As illustrated in Figure 5.2, the score of Remote Associates Test, Similarities Test - Fluency, Originality, Flexibility, and NEO-PI - Openness to Experience Test can be treated as normal distributions. However, only the distribution of the scores from Similarities Test - Elaboration is right-skewed.
<table>
<thead>
<tr>
<th></th>
<th>Pretest and posttest</th>
<th>Difference (posttest-pretest)</th>
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<td><img src="image" alt="Histogram" /></td>
</tr>
<tr>
<td><strong>Similarity Test - Fluency</strong></td>
<td><img src="image" alt="Histogram" /></td>
<td><img src="image" alt="Histogram" /></td>
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<tr>
<td><strong>Similarity Test - Flexibility</strong></td>
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<td><img src="image" alt="Histogram" /></td>
</tr>
<tr>
<td><strong>Similarity Test - Originality</strong></td>
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<td><img src="image" alt="Histogram" /></td>
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<tr>
<td><strong>Similarity Test - Elaboration</strong></td>
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<tr>
<td><strong>NEO-PI - Openness to Experience</strong></td>
<td><img src="image" alt="Histogram" /></td>
<td><img src="image" alt="Histogram" /></td>
</tr>
</tbody>
</table>

**Figure 5.2** Distribution of different variables
5.1.2 Correlation

Correlation can be described as the degree and kind of relationship between any two or more variables wherein they differ together over some time. It is among the most known forms of data analysis since it provides an analysis that stands on its own and because it underlies several other analyses. Correlation can effectively support inferences made after primary analyses are completed. It measures the strength of linear relations between two quantitative variables. In this regard, a correlation coefficient is utilized for measuring the strength of the relationship between numeric variables. In the present study, the numeric variables are the multiple relationships among the following: students' background information (e.g., gender, major, and previous cross-cultural experience), Remote Associate Test, Similarities Test, NEO-PI Test, and Weekly Reflection Writing Journal. This analysis answered several sub-questions in the study. Further, a correlation matrix was used to study the potential relationships among the following:

- Remote Associates Test
- Similarities Test - Fluency
- Similarities Test - Originality
- Similarities Test - Flexibility
- Similarities Test - Elaboration
- NEO-PI - Openness to Experience Test

The Pearson’s r correlation also referred to as the Pearson product-moment correlation, is the most widespread type of coefficient. It is utilized in computing the
degrees to which any two variables are linearly correlated. For this, variables may either be inversely related or conversely related. For an inverse relation, high values occur on one variable with low values for the other variables. Consequently, a direct or converse relation denotes high values on all variables. An instance occurs when there are high scores of the mean on the Remote Associate Test and the Similarities Test. Upon calculation, the r might range from -1 to +1. When r = -1, a perfect inverse relationship exists between the two variables, but when r = +1, there is a perfect direct relationship. Either -1 or +1 might mean that both variables are understandable. However, when r = 0, no correlation exists. Meanwhile, when r is either close to -1 or +1, the relationship is strong, but the correlation value (coefficient of the correlation) is usually not dependent on the specific measurement units used. An example is the correlation between the Remote Associates Test and Similarities Test, which are similar despite the units of measurement. Furthermore, proportionality is denoted by a linear relationship, meaning that the correlation is high when it is easy to “summarize” by a straight line sloping either downward or upward.

As illustrated earlier, the correlation coefficient (r) denotes the linear relationship between any two variables. When the correlation coefficient is squared, the resultant value of r, which is the coefficient of determination, signifies a common variation’s proportion in these two variables – the “strength” or “magnitude” of the relationship. When estimating the correlation between variables, the correlation’s strength should be identified first. Nonetheless, the analysis of r should mainly depend on the
research design, in which r is not a proportion or a percentage. In this case, an r of 50 may not necessarily show that it is part of something. A prediction is said to be very precise when two variables are correlated at -1 or +1 (perfect correlation), but where the correlation coefficient is -/+0.9 for example, the prediction is good even though it will be less accurate compared to that of a perfect correlation. When values are far from the perfect correlation, then the prediction results will be less accurate. Meanwhile, r will only denote a correlation relation and not a causal relation. Thus, linking two variables may not necessarily mean that one will cause the other.

5.2 Findings

5.2.1 Study Abroad Experience

Hypothesis:

Existing studies indicated that cross-culture experience could help people break traditional thought patterns and result in better creative abilities and openness scales. (Leung, Maddux, Galinsky & Chiu, 2008; Paletz & Peng, 2008; Cheng, & Leung, 2012). After controlling the baseline from the pretest. I predicted, design students in the treatment group scored significantly higher in all five major variables including, remote associate, fluency, flexibility, originality, and openness.

Step 1: Independent-sample t-test

An independent t-test was applied in testing the variables scored on the creativity tests (Remote Associate Test and Similarity Test) and NEO-PI Openness Test.
Since there are multiple test in this study, a Bonferroni correction was applied to the t-test. This study has $\alpha = 0.05$, and 5 tests, so the Bonferroni correction adjusted the $p$-values to smaller than 0.01. These tests established whether significant differences existed between the control and the treatment groups. The t-tests for every testing period before the NC State Prague Study Abroad Program (pre-test) indicate that scores of all variables were established not to be statistically significant (Table 5.1). These findings also reveal that all participants shared the same baseline regarding creative thinking and openness skills ($p$-value > 0.01), which was expected for creating equivalent groups for the control and treatment groups.

Table 5.1 Study Abroad Independent-sample t-test - Pre test

<table>
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<tr>
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<th>Study Abroad</th>
<th>Control</th>
<th>df</th>
<th>p</th>
</tr>
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<td>M</td>
<td>SD</td>
</tr>
<tr>
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<td>Originality</td>
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</tr>
<tr>
<td>Openness</td>
<td>133.48</td>
<td>9.75</td>
<td>132.65</td>
<td>10.22</td>
</tr>
</tbody>
</table>

An independent t-test was applied in testing the effects of the cross-cultural experience (study abroad) on the same variables. This test compared the scores of the control and treatment groups after the NC State Prague Study Abroad Program (post-test). The results show a significant difference on some creative thinking variables (Table 5.2). On average, students who participated in the NC State Prague Study Abroad Program scored higher on the originality compared to the
scores of students who did not participate in the NC State Prague Study Abroad Program (p-value < 0.01).

Table 5. 2 Study Abroad Independent-sample t-test - Post test

<table>
<thead>
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<th>p</th>
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</tr>
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<tr>
<td>Openness</td>
<td>134.98</td>
<td>9.68</td>
<td>133.41</td>
<td>9.60</td>
</tr>
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</table>

Step 2: Paired-sample t-test

Another way of analyzing the pre-study and post-study is using the paired-sample t-test. The independent-sample t-test has more freedom, meaning it is more likely to detect differences but might not necessarily control the effects of the environment. The paired-sample t-test must be utilized in the case of two sample means and where there is an intrinsic relationship between the observations collected in both samples. For instance, in the pre-study and the post-study, the same individual is sampled each time, and there is a clear non-independent relationship between the samples. In this way, the paired-sample t-test controls for effects of the environment, but the degrees of freedom are lower; hence, it might be harder to reject the $H_0$. The advantage of choosing a paired-sample t-test is to eliminate the individual differences that occur between participants - the concept is that no two people are the same - which increases the power of the test. Therefore, application of the
paired-sample t-test is more probable for detecting a statistically significant difference, if it exists.

For this study, the paired-sample t-tests were used to compare the variables scores on the creativity and openness test between different testing periods (pre-test and post-test). This was designed to detect whether there was a significant difference in the creativity and openness scores for both the control and treatment groups. Two separate paired-sample t-tests were carried out to compare the creativity and openness scores among the students who participated in the NC State Prague Study Abroad Program (treatment) and those who remained at NC State University (control).

The results (as illustrated in Table 5.3 and 5.4) reveal that for the students who participated in the NC State Prague Study Abroad Program (treatment), there was a significant improvement in all five variables including the RAT, fluency, flexibility, originality and openness. The scores for the Remote Associate Test with post-test (M=27.53, SD=10.72) and pre-test (M=25.31, SD=12.00); t (95) =4.58, p < 0.001. For the students who remained at NC State University, no significant difference in the scores for the Remote Associate Test was detected; post-test (M=25.33, SD=8.02) and pre-test (M=25.41, SD=8.21); t (38) =-0.14, p = 0.887.

Results comparing scores from the pre-test and post-test establish that the fluency scores are significantly different for both the control and the treatment groups; treatment: t (106) = 5.45, p < 0.001; control: t (38) = -2.88, p = 0.007 < 0.01. Students
in the treatment group averaged higher scores on the post-test (M=36.75, SD=11.88) compared to their pre-test scores (M=35.23, SD=12.88). Conversely, students in the control group averaged lower scores on the post-test; (M=33.64, SD=13.32) compared to their pre-test scores (M=35.04, SD=14.46).

The results for the flexibility show their scores were significantly different in the treatment: t (108) = 5.15, p<0.001; and no significant was found in the control group, control: t (38) = -0.26, p= 0.079 >0.01. Students in the treatment group averaged higher scores on the post-test; (M=2.022, SD=7.28) compared to the pre-test; (M=18.48, SD=7.53), same with the students in the control group averaged slightly higher scores on the post-test; (M=17.81, SD=6.66) compared to the pre-test (M=17.23, SD=7.86). The findings of the originality show a significant increase from the treatment group; post-test (M=5.23, SD=3.36) and pre-test (M=4.26, SD=3.16); t (106) =8.01, p < 0.001. For the students who remained at NC State University, no significant difference was observed; post-test (M=3.87, SD=2.45) and pre-test (M=3.87, SD=2.73); t (38) =0, p =1.

Further, a significant improvement in the scores for NEO-PI-Openness Test in the treatment group was observed; post-test (M=134.98, SD=9.68) and pre-test (M=133.48, SD=9.46); t (73) =3.13, p=0.0025 < 0.1. Consequently, for the control group, there was no significant difference in the scores for NEO-PI-Openness Test; post-test (M=134.18, SD=9.60) and pre-test (M=133.69, SD=10.22); t (38) = 0.89, p = 0.38.
Summarily, these pre-paired and post-paired sample t-tests suggest that the students who participated in the NC State Prague Study Abroad Program (treatment) experienced a significant improvement in all the variables of creative thinking skills (measured by the Remote Associate Test and Similarity Test) and openness level (measured by the NEO-PI Openness to Experience Test). In the meantime, the students who stayed in the NC State University (control group) had a major decrease in fluency, and there were no significant differences on all other variables.

Table 5. 3 Pre-and Post-Paired-sample T-test - Study Abroad

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pretest</th>
<th>Posttest</th>
<th>df</th>
<th>t-ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>RAT</td>
<td>25.31</td>
<td>12.00</td>
<td>27.53</td>
<td>10.72</td>
<td>95</td>
</tr>
<tr>
<td>Fluency</td>
<td>35.23</td>
<td>12.88</td>
<td>36.75</td>
<td>11.88</td>
<td>106</td>
</tr>
<tr>
<td>Flexibility</td>
<td>18.48</td>
<td>7.53</td>
<td>20.22</td>
<td>7.28</td>
<td>108</td>
</tr>
<tr>
<td>Originality</td>
<td>4.26</td>
<td>3.16</td>
<td>5.23</td>
<td>3.36</td>
<td>106</td>
</tr>
<tr>
<td>Openness</td>
<td>133.48</td>
<td>9.76</td>
<td>134.98</td>
<td>9.68</td>
<td>73</td>
</tr>
</tbody>
</table>

Table 5. 4 Pre-and Post-Paired-sample T-test - Control

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pretest</th>
<th>Posttest</th>
<th>df</th>
<th>t-ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>RAT</td>
<td>25.41</td>
<td>8.21</td>
<td>25.33</td>
<td>8.02</td>
<td>39</td>
</tr>
<tr>
<td>Fluency</td>
<td>35.04</td>
<td>14.46</td>
<td>33.64</td>
<td>13.32</td>
<td>38</td>
</tr>
<tr>
<td>Flexibility</td>
<td>17.23</td>
<td>7.86</td>
<td>17.81</td>
<td>6.66</td>
<td>38</td>
</tr>
<tr>
<td>Originality</td>
<td>3.87</td>
<td>2.73</td>
<td>3.87</td>
<td>2.45</td>
<td>38</td>
</tr>
<tr>
<td>Openness</td>
<td>133.69</td>
<td>10.22</td>
<td>134.18</td>
<td>9.60</td>
<td>38</td>
</tr>
</tbody>
</table>
Step 3: Independent t-test with difference

Another independent t-test tested the effect of the Study Abroad Program on the score differences on the creativity tests (Remote Associate Test and Similarity Test) and NEO-PI Openness Test. The concept of this procedure is to calculate the differences between the pre-test and post-test and make an independent t-test between the treatment and control groups. The design aimed to determine if participating the NC State Prague Study Abroad Program (treatment) can change students' creative thinking and openness levels. The results reveal a significant difference in creative thinking variables (Table 5.5). Students who participated in the NC State Prague Study Abroad Program show a significant difference in scores on the Similarities Test (fluency, flexibility, originality) compared to students who did not participate in the NC State Prague Study Abroad Program (p-value < 0.01).

An independent groups t-test of the Remote Associate Test (RAT) reveals that there is no significant difference between the treatment group (M=2.32, SD=4.97) and control group (M=-0.08, SD=3.36), p=0.065 > 0.01. A t-test on Similarities-fluency indicates a significant difference between the treatment group (M=2.12, SD=4.03) and the control group (M=-2.38, SD=5.17), p < 0.001. A t-test of Similarities-flexibility reveals that the treatment group (M=2.15, SD=4.62) differed from the control group (M=-1.25, SD=5.57) as predicted, p < 0.001. A t-test on Similarities-originality shows that the treatment group (M=1.30, SD=1.68) differed from the control group (M=0, SD=1.64) as predicted, p < 0.001. In all creative tests, the mean of difference on the treatment group is larger than 0, while the control group is below
or equal to 0, marking an improvement in the treatment group and a decrease in the control group. In addition, student scores from the NEO-PI Openness Test are determined to be non-significant; the data indicated the treatment group scores (M=1.08, SD=2.97) are slightly higher than those of the control group (M=0.49, SD=3.41), but no statistical significance was found, p =0.339 > 0.01.

Table 5. 5 Independent-sample t-test - pre-and post-difference

<table>
<thead>
<tr>
<th>Variable</th>
<th>Study Abroad</th>
<th>Control</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>RAT</td>
<td>2.32</td>
<td>4.97</td>
<td>-0.08</td>
<td>3.36</td>
</tr>
<tr>
<td>Fluency</td>
<td>2.12</td>
<td>4.03</td>
<td>-2.38</td>
<td>5.17</td>
</tr>
<tr>
<td>Flexibility</td>
<td>2.15</td>
<td>4.62</td>
<td>-1.25</td>
<td>5.57</td>
</tr>
<tr>
<td>Originality</td>
<td>1.30</td>
<td>1.68</td>
<td>0</td>
<td>1.64</td>
</tr>
<tr>
<td>Openness</td>
<td>1.08</td>
<td>2.97</td>
<td>0.49</td>
<td>3.41</td>
</tr>
</tbody>
</table>

Summary

Both independent and paired t-tests have supported the hypothesis to some degree. From the average score view, these independent-sample t-tests reveal that the students from the study abroad group and control group share the same baseline (no significant difference in the pre-test), but the study abroad group scored significantly different on originality. Moreover, the result from the independent t-test with difference indicates that the study abroad experiences significantly enhanced students' fluency, flexibility and originality measured by the Similarity Test.
From the individual difference view, the paired sample t-tests results suggest that the students who participated in the NC State Prague Study Abroad Program (treatment) experienced a significant improvement in all the variables of creative thinking skills (measured by the Remote Associate Test and Similarity Test) and openness level (measured by the NEO-PI Openness to Experience Test). In the meantime, the students who stayed in the NC State University (control group) had a major decrease in fluency, and there were no significant differences in all other variables.

5.2.2 Journal Analysis

Weekly reflection journals were used as secondary data. Fifty-six students participated in the journal group (126 in the non-journal group). The researcher asked students to write about the most interesting and unusual experience or unexpected activities happening every week. The goal of the reflection journal was to understand what kinds of experiences challenge students' normal way of thinking and to provide insight into the reasons why and how the study abroad experience may cause changes in students' creativity. The journal analysis was accomplished in a couple of different ways. First, t-tests were used to explore whether the journal writing during the study abroad experience enhances students' creativity. Another way was to categorize the journals into groups to see what kinds of activity and experience were most mentioned. Also, the journal word frequency mapping and a writing attitude analysis were done on selected students.
5.2.2.1 T-Test

**Hypothesis:**
Existing studies indicated recalling and writing about a multicultural experience enhanced individuals' cognitive complexity and flexibility. (Leung et al., 2008; Maddux & Galinsky, 2009, 2010). I predicted, design students who kept the weekly reflection journal writing about the study abroad experience demonstrated significantly higher RAT and flexibility scores in the post-test.

**Step 1: Independent-sample t-test**

Among the students who participated in the NC State Prague Study Abroad Program, there was a portion of them who took a weekly reflection journal (journal group), while the remaining others did not (non-journal group). A similar procedure was applied to analyze whether the weekly reflection journal writing influenced students' scores on the creativity tests (Remote Associate Test and Similarity Test) and NEO-PI Openness tests, both within the journal group and non-journal group.

The t-tests for each of the testing periods before the NC State Prague Study Abroad Program (pre-test) revealed that scores of all variables were established not to be statistically significant (Table 5.6). These findings reveal that all participants in the NC State Prague Study Abroad Program share the same baseline in terms of creative thinking and openness skills (p-value > 0.01). This was expected for creating equivalence for the weekly reflection journal group.
An independent t-test compared the scores of the journal and non-journal groups after the NC State Prague Study Abroad Program (post-test). This test was applied to establish whether there were any differences between the journal and non-journal groups in terms of the students’ creative thinking and openness skills after the study abroad program. The results (as shown in Table 5.7) reveal no significant difference in the Remote Associate Test, Similarities Test, and NEO-PI-Openness (p-value >0.01). This indicates, on average, among the students who submitted the weekly reflection journal and those who did not, all performed almost the same on the post-test.

Table 5.6 Journal Analysis Independent-sample T-test - Pre-test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Journal</th>
<th>Non-journal</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M  SD</td>
<td>M  SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAT</td>
<td>24.21 11.78</td>
<td>26.18 12.19</td>
<td>110.91</td>
<td>0.377</td>
</tr>
<tr>
<td>Fluency</td>
<td>33.75 12.79</td>
<td>36.42 12.93</td>
<td>109.92</td>
<td>0.268</td>
</tr>
<tr>
<td>Flexibility</td>
<td>17.96 6.89</td>
<td>18.89 8.02</td>
<td>109.26</td>
<td>0.509</td>
</tr>
<tr>
<td>Originality</td>
<td>4.04 3.12</td>
<td>4.43 3.20</td>
<td>110.60</td>
<td>0.505</td>
</tr>
<tr>
<td>Openness</td>
<td>132.37 10.54</td>
<td>134.40 9.04</td>
<td>87.13</td>
<td>0.307</td>
</tr>
</tbody>
</table>

Table 5.7 Journal Analysis Independent-sample T-test - Post-test

<table>
<thead>
<tr>
<th>Variable</th>
<th>Journal</th>
<th>Non-journal</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M  SD</td>
<td>M  SD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAT</td>
<td>27.02 10.62</td>
<td>27.90 10.86</td>
<td>100.40</td>
<td>0.670</td>
</tr>
<tr>
<td>Fluency</td>
<td>36.51 11.31</td>
<td>36.94 12.38</td>
<td>116.00</td>
<td>0.842</td>
</tr>
<tr>
<td>Flexibility</td>
<td>20.91 7.18</td>
<td>19.70 7.36</td>
<td>118.90</td>
<td>0.365</td>
</tr>
<tr>
<td>Originality</td>
<td>5.38 3.18</td>
<td>5.12 3.51</td>
<td>116.35</td>
<td>0.671</td>
</tr>
<tr>
<td>Openness</td>
<td>134.43 10.72</td>
<td>135.40 8.90</td>
<td>69.39</td>
<td>0.660</td>
</tr>
</tbody>
</table>
Step 2: Paired-sample t-test

Two separate pre-paired samples t-tests and post-paired samples t-tests were carried out to compare the scores of creativity and openness in these two distinct groups.

The results (as displayed in Table 5.8 and 5.9) denote that for the students who took the weekly reflection journal while on the study abroad, there was a significant improvement in the scores for Remote Associate Test with post-test (M=26.87, SD=10.63) and pre-test (M=24.46, SD=11.78); t (45) =3.54, p= 0.001<0.01. But for the students in the non-journal group, there was a significant difference in the scores for Remote Associate Test as well; post-test (M=27.36, SD=10.86) and pre-test (M=25.12, SD=12.19); t (49) =2.98, p = 0.005 < 0.01.

Comparable results were also noticed in the Similarity Test- originality, where both journal and non-journal groups scored significantly differently. The journal group: t (51) = 6.56, p< 0.001; while the non-journal group: t (54) = 4.91, p< 0.001. The students in the journal group scored averagely higher at the post-test; (M=5.46, SD=3.18) compared to the pre-test; (M=4.04, SD=3.12), whereas the students in the non-journal group scored averagely higher at the post-test; (M=5.49, SD=3.51) as compared to the pre-test (M=4.31, SD=3.20).

There were further significant improvements in the scores for fluency and flexibility, in the journal group, while there was no significant difference in the non-journal group. The journal group: t (51) = 5.52, p< 0.001; while the non-journal group: t (54)
= 2.45, p= 0.017 > 0.01. Accordingly, the students in the journal group scored averagely higher at the post-test; (M=36.69, SD=11.31) as compared to the pre-test; (M=33.75, SD=12.79). On the other hand, the students in the non-journal group scored averagely higher at the post-test; (M=36.69, SD=12.38) as compared to the pre-test; (M=35.35, SD=12.93). For flexibility, the journal group: t (51) = 4.63, p= 0.001< 0.01; while the non-journal group: t (56) = 2.66, p= 0.01. Consequently, students in the journal group scored averagely higher at the post-test; (M=20.91, SD=7.18) as compared to the pre-test (M=17.96, SD=6.89). On the other hand, the students in the non-journal group scored averagely higher at the post-test; (M=19.70, SD=7.36) as compared to the pre-test; (M=18.89, SD=8.02). There was also a significant improvement in the scores for NEO-PI-Openness Test in the journal group, post-test; (M=134.44, SD=10.72) and pre-test; (M=133.06, SD=10.54); t (35) =3.24, p=0.003 < 0.01. But for the non-journal group, there was no significant difference in the scores for NEO-PI-Openness Test, post-test; (M=135.63, SD=8.90) and pre-test’ (M=134.82, SD=9.04); t (37) = 1.50, p = 0.142.

Table 5. 8 Pre-and Post-Paired-sample t-test - Journal Group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pretest</th>
<th>Posttest</th>
<th>df</th>
<th>t-ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>RAT</td>
<td>24.46</td>
<td>11.78</td>
<td>26.87</td>
<td>10.63</td>
<td>45</td>
</tr>
<tr>
<td>Fluency</td>
<td>33.75</td>
<td>12.79</td>
<td>36.69</td>
<td>11.31</td>
<td>51</td>
</tr>
<tr>
<td>Flexibility</td>
<td>17.96</td>
<td>6.89</td>
<td>20.91</td>
<td>7.18</td>
<td>51</td>
</tr>
<tr>
<td>Originality</td>
<td>4.04</td>
<td>3.12</td>
<td>5.46</td>
<td>3.18</td>
<td>51</td>
</tr>
<tr>
<td>Openness</td>
<td>133.06</td>
<td>10.54</td>
<td>134.44</td>
<td>10.72</td>
<td>35</td>
</tr>
</tbody>
</table>
Table 5. 9 Pre-and Post-Paired-sample t-test - Non-journal Group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pretest M</th>
<th>SD</th>
<th>Posttest M</th>
<th>SD</th>
<th>df</th>
<th>t-ratio</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAT</td>
<td>25.12</td>
<td>12.19</td>
<td>27.36</td>
<td>10.86</td>
<td>49</td>
<td>2.98</td>
<td>0.005</td>
</tr>
<tr>
<td>Fluency</td>
<td>35.35</td>
<td>12.93</td>
<td>36.69</td>
<td>12.38</td>
<td>54</td>
<td>2.45</td>
<td>0.017</td>
</tr>
<tr>
<td>Flexibility</td>
<td>18.89</td>
<td>8.02</td>
<td>19.70</td>
<td>7.36</td>
<td>56</td>
<td>2.66</td>
<td>0.010</td>
</tr>
<tr>
<td>Originality</td>
<td>4.31</td>
<td>3.20</td>
<td>5.49</td>
<td>3.51</td>
<td>54</td>
<td>4.91</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Openness</td>
<td>134.82</td>
<td>9.04</td>
<td>135.63</td>
<td>8.90</td>
<td>37</td>
<td>1.50</td>
<td>0.142</td>
</tr>
</tbody>
</table>

Summary

In summary, the independent-sample t-tests demonstrated that students from the journal and non-journal group share the same base-line in terms of creativity and openness levels (measured by the Remote Associate Test, Similarity Test, and NEO-PI Openness Test).

The paired sample t-tests result indicated that the students who took a weekly reflection journal significantly improved all variables of creative thinking skills (measured by Remote Associate Test and Similarity Test), and openness level (measured by NEO-PI Openness to Experience Test). On the other hand, the students in the non-journal group significantly improved convergent thinking (measured by the Remote Associate Test) and originality (measured by the Similarity Test). However, there are no significant differences among all other variables. In other words, the study abroad treatment impact students' creativity in the aspect of convergent thinking and originality. But with the recalling of reflection...
journal, the enhancement can be expanded to all the variables including RAT, fluency, flexibility, originality and openness.

5.2.2.2 Journal Categories

The journal entries can be separated into three categories based on the content. In the first category, the journal content relates to life and study abroad with descriptions of local information such as places, culture, language, and interaction with people. The students expressed what they saw, what they heard, the status they encountered, and how these situations triggered their feelings. The majority of journals belong to this category. In the second category, students mainly described what they felt about themselves and the skills they learned by living abroad. For instance, some students learned how to do laundry at a laundromat. Their feelings were irrelevant to the local situations except the weather, such as illness caused by the cold weather. In the third category, students mainly described what they were going to learn and study. In other words, they expressed their objectives and tasks in their journals. Local information including culture, language, and history was only briefly mentioned.

The reflection journal analysis identifies key words to categorize information. After the journals were fully read, some identifiers, i.e., key informational words, were employed to tag and refine themes. Notes were kept for data interpretation. The related themes were then combined into several subclasses, which were labeled using descriptive phrases or selecting words and key phrases from the texts. A short
A description was written for each subclass by giving examples from the journals illustrating the definition. A second reviewer checked the validity of the subclasses. The reviewer received a random selection of 30 journal entries (of 122 in total). The reviewer was asked to read the texts and fill in the 14 subclasses in the 30 journals. Next, the researcher’s and reviewer’s results were compared. Minor changes were made to achieve the result.

Based on the procedure described above, the journal entries were classified into 14 subclasses, displayed in Figure 5.3. The keyword subclasses contain interaction with people, travel, culture, self-learning, language, research, history, transportation, food, shopping, building, weather, communication, and missing home. Among them, interaction with people and travel were mentioned more frequently than others. In total, 62 and 58 journals referred to interaction with people and travel, respectively. When students described how they talked with people and where they arrived, they usually employed more words and phrases to provide details and express their feelings. For example, one student went to the Bavarian Alps for hiking and used several positive adjectives to describe the beautiful scenery and the amazement brought by the local ecosystem. Another remarkable finding is that the description of travel is always related to the local culture, language, history, and/or buildings. For example, one student visited cities around Prague, reached the Bone Church, and learned the history of the Black Plague and the mass murders during the plague.
In classifying the journals based on keywords, travel and transportation were separated into two different classes, since travel is related to the scenery students saw and the situations they met during their visit. Transportation is mainly associated with the convenience or complexity of the local transportation system. Besides, interaction with people and communication cannot be merged into one class. When students described their interactions with people, they depicted the interaction through languages or face-to-face gestures, and how friendly or hostile
the people were. On the other hand, communication is related to communication tools and techniques such as cell phones and laptops, which draw the distance between people around the world close via voice and video chat.

Since the keywords interaction with people and travel were used by most of the journals, they can be further categorized into several subclasses as shown in Figure 5.4 and Figure 5.5. The subclasses of interaction with people include the interaction with local people (51%), people from the home country (9%), students and friends (7%), people from other countries (4%), and a brief description (general 29%). For instance, one student talked with local restaurant workers and shop workers while shopping and found most of them dislike tourists; one student went to a Mexican restaurant and surprisingly found several people from North Carolina and felt the geniality of talking with them; one student spent time with colleagues in the same studio and had dinner together.
Figure 5.4 Interaction with People Sub-categories

In Figure 5.5, the class about travel can be further classified into visiting cities (45%), places of interest (12%), local places (11%), non-tourist area (5%), scenery (2%), and a brief description (general 25%). For instance, many students traveled to different cities in Europe and gained a lot of memorable experiences; one student explored a local semi-abandoned island to experience a thriving and self-sufficient culture; one student went to a non-tourist-oriented store that sold authentic Venetian goods for gifts.
To deconstruct the journals, the researcher selected the journals from the individuals who changed most and least in their tests scores. Each of the students had two sets of scores - the pre-and post-scores of RAT, fluency, flexibility, originality, elaboration, and openness. The researcher subtracted the pre-test score from the post score to find the differences in each test, and the five test scores added together produced the total changing score. Figure 5.17 shows the distribution of each individual’s total changing score, and the 20 individuals with the highest total changing scores were selected as the most change group, while the lowest 20 as the least change group. As shown in Figure 5.6 and Table 5.10, the average

**Figure 5.5 Travel Sub-categories**

**5.2.2.3 Word Frequency**

To deconstruct the journals, the researcher selected the journals from the individuals who changed most and least in their tests scores. Each of the students had two sets of scores - the pre-and post-scores of RAT, fluency, flexibility, originality, elaboration, and openness. The researcher subtracted the pre-test score from the post score to find the differences in each test, and the five test scores added together produced the total changing score. Figure 5.17 shows the distribution of each individual's total changing score, and the 20 individuals with the highest total changing scores were selected as the most change group, while the lowest 20 as the least change group. As shown in Figure 5.6 and Table 5.10, the average
change score of the most change and least change groups are quite different in each aspect of creativity.

![Total Changing Score Distribution](image)

**Figure 5.6 Individuals' Distribution of the Total Changing Score**

**Table 5.10 Average Difference Score**

<table>
<thead>
<tr>
<th></th>
<th>Average Test Score Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RAT</td>
</tr>
<tr>
<td>Change most</td>
<td>4.79</td>
</tr>
<tr>
<td>Change least</td>
<td>-0.18</td>
</tr>
</tbody>
</table>
The word frequency and attitude analysis used the NVivo software. The word frequency diagram (Figure 5.7) shows the most mentioned words in students’ journals. Both the most and least change groups focused on “learn,” which is no surprise since this was a study abroad program in which students came to learn. For the most change group, the student journal writing focused more on “experience,” while the least change group is focused more on “expect” and “get.” Students who have specific expectations to learn and get may benefit less during the study abroad program than the students who value and enjoy the cross-cultural experience.

![Word Frequency Diagrams](image)

**Figure 5. 7 Words Frequency**
5.2.2.4 Writing Attitude Analysis

Another interesting finding was detected in the attitude analysis done by NVivo software as well. People write journals with different emotions; researcher believed these emotions can provide some clues in terms of whether the attitude affects the enhancement of creativity during the study abroad experience. Each of the journals was tagged as a positive, moderate or negative label; examples were shown in below:

Positive:

*This past week, I have learned that I am a surprisingly decent (perhaps even good) cake decorator. Last week, I partnered with a friend of mine in out Czech Culinary Arts and Culture class to decorate a large pastry, and this week did so again for a miniature cake. Our cake was a favorite of our classmates, with even our instructor taking a photo of it! Many other students took photos of our cake, which was pink with white stripes and flowers, with a single yellow rose on top. We jokingly declared that if Architecture doesn’t work for us, we can own our own bakery, and if we team up again for more decorations, surely we will explore these talents more. Not only have I found cake decorating to be fun, but a potential hidden talent.*

Moderate:

*As I am only taking an Industrial Design studio taught by familiar faces, most of what I expect to learn comes from the city itself. I expect to learn about the culture here in*
Prague, and how staying somewhere for longer than a week-long family vacation can come to influence my design decisions and way of viewing the world. I hope to better humble myself and get rid of my American superiority complex, and learn to appreciate not just the culture I am being immersed in, but also the cultures of the many people passing through the city. Mostly I want to meet a few locals and learn what life is really like here in Prague, so as long as I can make a few new friends, I am fully looking forward to that learning experience.

Negative:

I was trying to purchase groceries at a local store and my money bill was too large to change and they would not accept it (which I found strange because in the US money is generally taken regardless of the amount). I therefore had to use my debit card (which I really hate doing) in order to pay for an amount less than $20 for the week’s groceries. The card was not a side-slide as I would have expected and the cashier’s English made it very difficult for me to understand that I needed to insert the card in order for it to register. I got very flustered because the cashiers I have dealt with in this country have been very impatient with customers. I got scared and a friend tried to help, though unsuccessfully. Eventually I understood what I needed to do and paid. I don’t like to do things incorrectly and I thought I would have picked up or observed the act of paying. It wasn’t unusual so much as it made me uncomfortable and annoyed with myself.
As shown in Figure 5.8, the positive attitude percentage coverage was similar in the most change (21.8%) and least change (23.3%) group, but the negative attitude percentage in the least change group (34.8%) is much larger than that of the most change group (11.9%), indicating that a negative attitude may weaken the students’ benefits from the study abroad experience.

Figure 5.8 Writing Attitude Analysis

5.2.3 Correlation

Correlation, as a secondary analysis for this study, was imperative in supporting deductions made after performing the primary analyses. Several quantitative numeric variables were investigated for measuring the strength of their relationships. Most variables covered the measures of creative thinking, such as convergent thinking and divergent thinking. Additionally, scores from the openness to experience portion also included a measure of personality traits.
Correlation measures the levels to which any two given variables are linearly linked and may differ simultaneously. Correlation efficiently enabled the researcher to examine the strength of all possible relationships among investigated variables in this study. The output matrix with all the relationships and information concerning their strength was also exhibited together, in which significant relationships could be established and tested in depth. Through an examination of those significant relationships, several questions were addressed:

- **Are there correlations among various components of divergent thinking skills (fluency, flexibility, and originality)?**

- **Is there a correlation between convergent thinking and divergent thinking skills?**

- **Is there a correlation between openness measured by the NEO-PI Test and creativity measured by the Remote Associate Test and Similarity Test?**

To begin, the researcher examined whether relationships exist among the various components of divergent thinking skills, including the relationship between the students’ scores on the Similarity Test and the creativity test (fluency, flexibility, and originality). A significant positive correlation (as illustrated in Table 5.1) was present between fluency, flexibility, and originality scores on the Similarities Test (p<0.01). Accordingly, students with high fluency scores also exhibit high flexibility and originality scores, thus supporting the assumption that before students can generate truly original responses to problems, they must first focus on generating as many other alternative solutions as possible. As they reach a high number of solutions,
the catalogs expand. The process of generating alternatives allows for original responses to become apparent.

Another major purpose of the correlation is to determine whether a relationship exists among the various types of creative thinking skills. This involved investigating the relationship between students’ scores on various creativity tests (Remote Associates Test and Similarities Test). Both convergent and divergent thinking are essential to creative thinking, there was a significant uphill (positive) linear relationship between the scores on the Remote Associates Test and the Similarities Test. Although these two tests measure two entirely different types of thinking (RAT – convergent thinking / SIM – divergent thinking), which requires different modes of thinking. The positive correlation indicates students with high convergent thinking ability also tend to have high divergent thinking ability, thus both divergent and convergent thinking are required in order to be creative.

Many researchers believe that creativity is related to personality, especially openness. Individuals with high openness levels tend to be more acceptable of different environments and situations, which may heighten one's creativity. Based on this study’s correlation analysis, a significant uphill (positive) linear relationship exists between the scores on NEO-PI and any creativity tests (Remote Associates Test, Similarities Test).
<table>
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<td>Openness</td>
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*Note. *p*<.05, **p*<.01*
CHAPTER 6. CONCLUSIONS

6.1 Generalizing Findings

Most of the findings support this study’s primary hypothesis. Students who were enrolled in the NC State Prague Study Abroad Program (treatment) scored significantly higher on the post-test of the Remote Associate Test (RAT) and Similarities Test (flexibility, originality) than those who did not participate in study abroad (control). The former students (treatment) displayed a significant improvement in different variables of creative thinking skills - convergent thinking, fluency, flexibility, and originality - according to the results of the Remote Associate Test and Similarity Test, and openness skills as measured by NEO-PI, while students in the control group showed a major decrease in fluency. No significant differences appeared among the other variables. These findings indicate that the NC State Prague Study Abroad Program (treatment) has a positive effect on students’ creativity and openness skills based on the Remote Associate Test, Similarities Test, and NEO-PI.

Within the study abroad program, the students who participated in weekly reflection journal writing considerably improved in all variables of creative thinking and openness skills (measured by the Remote Associate Test, Similarity Test and NEO-PI). The students in the non-journal group showed significant improvement only in convergent thinking (measured by the Remote Associate Test), and originality (measured by the Similarity Test). This result reveals that the study abroad
experience enhanced students’ creativity in the aspect of originality, and by recalling the experience through reflection journal writing, student benefits may further escalate. The journal writing analyses also indicated the major impact of the study abroad program came from the interaction with people and travel experience. Students who have specific expectations to learn and get and with negative attitude may benefit less during the study abroad program than the students who value and enjoy the cross-cultural experience. Negative attitudes may limit the impact of study abroad.

6.2 Application to Design Education

Creativity and designing skills are the two primary requirements for designers. Creativity governs new idea generation, and designing skills can transfer the idea to useful articles, products, and projects. In college education, design is the discipline of innovation. The aim of design education is fostering creative abilities along with imparting technical skills and a broader knowledge base, which is the essential requirement of a successful designer. On the other hand, global awareness is fundamental to the practice of design. More companies choose the international cooperation, and globalization is an inevitable tendency for design field. As a result, cross-cultural collusion and integration are inevitable. Designers must be sensitive to and able to work productively with increasingly diverse clients and user groups.

Taking global integration into consideration, the concepts of design programs are being expanded to enrich the knowledge and understanding of students. Study
abroad is one of the pioneers in many leading design programs. The NC State Prague Institute was founded in 1991 and offered study abroad opportunities for students at NC State University ever since. Educators believe such experiences bring students into a field they were not previously exposed to before. The findings in this study provide strong support for the statement that study abroad can be treated as a necessity in high-level design education. Meanwhile, this study also supplies and discusses some strategies for improving creativity, such as reflection journal writing, to maximize the creativity benefit of a study abroad program. This study has started to explore the reason "why" and try to understand what kind of unique experience causes change. Researchers believe that with cross-cultural experience, students can not only enhance their creativity but also establish social connections between diverse cultures and their design skills and learn to collaborate with communities to launch local design projects that embrace native materials and construction practices.

6.3 Limitations and Future Research Directions

One major limitation of this study is the sample size. For each semester 30 to 70 students participated in the Prague Institute Study Abroad Program. Since this research study was not a requirement for the Study Abroad Program and students volunteered to participate, there were only 20 to 30 participants in the treatment group every semester, and the sample size was 131 in the treatment group across all six semesters. There was also only one control group of 51 participants. Future
research should use a different method to encourage and inspire students to take part in the research study.

Due to the small number of students participating in the reflection journal writing within the control group, valid statistical comparisons could not be made. In the future, an effort should be made to study reflection journal writing and its relationship with creativity not only in the treatment group but also in the control group.

The program included 12 reflection journal prompts. Most students who keep a reflection journal did not complete all of them, and only a few finished all 12 journals throughout the semester. Future research may focus on the consistency of journal writing and expand the journal format to photos, videos, and drawings, not just writing only.

Future work also should examine different study abroad programs, determining whether and how the destination and duration of the study abroad experience affects students' creativity.

Another future study direction would be to set up an interview/ focus group with the students who participated in the Study Abroad Program to discuss the unique or valuable thing they learned in the study abroad experience compared to the regular design education. Follow up research could track and compare the future academic behavior and career achievements of focus group participants.
For further statistic analysis, ANOVA, MANOVA should be considered. Also, researchers plan to transfer all the test scores into standardized scores, in order to be better compare scores for different groups of people as well as compare scores on different tests.
REFERENCES


