

# **The Effect of Language Ability in Creativity Assessment**

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## **Abstract**

Creativity is widely acknowledged and manifested a universal human experience, yet its definitions and assessments are complex and vary in different cultures. This paper aims at exploring the effect of English language ability on university students' creativity assessment. With two studies, the investigation was conducted among students of English as a Second Language (ESL) and Native Speakers of English (NSE). Creativity assessment test Torrance Test of Creative Thinking (TTCT) was used in both a United States university class and a Chinese university class. The Alternative Use Test (ALT) and Remote Associates Test (RAT) were used in the US university class. All three tests are a widely used means to evaluate an individual's creative ability. These tests require some degree of written text to communicate the creative concepts.

The TTCT, ALT and RAT were used by US students in the first study. As hypothesized, the results indicated a significant difference in creative ability between ESL and NSE students, with NSE students' scores being much higher than that of ESL students. Scores of TTCT revealed no strong correlation between self-rating of English ability and creativity. It was hypothesized that the language in which the test is taken is a critical factor.

A second study was conducted among Chinese university students (ESL) with the TTCT. Approximately half of the students were given the TTCT in Mandarin; the other half was given the test in English. Disproving our hypothesis, there was no significant difference in creativity scores, showing that English ability was not a critical factor in the TTCT. However there is a significant difference when comparing TTCT scores of the Chinese students to that of the NSE students. This data suggests that Chinese students are likely less creative than NSE students as evaluated by the TTCT.

Factors which affect the result of creativity assessment are various, of which language plays certain functions in the aspect of opening up individuals' vision, inspiring their imagination and better understanding the works of art from other cultures. In the last part of this thesis, the author points out that when making a fair and reliable conclusion about individual's creative ability, elements in social, cultural and educational diversities should certainly be included.

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## 1. Introduction

Creativity and creative concepts are very important to the development of a society as it is the heart of innovation, which can significantly change or improve people's life. The concept of creativity is complex and it varies in different cultures due to different focuses on it. An individual's creativity can be displayed in different forms, ranging from the writing of literary works, drawing and painting to the making of products by hand. Many factors such as cultural environment, education, personality *etc.* contribute to the cultivation and improvement of one's creativity, and among them foreign language ability plays an important role which can never be neglected when creativity assessment is made. Industry and academia desire creative individuals to find problems and develop novel solutions. Thus understanding the concept and the criteria of creativity and having the knowledge of how to assess creativity is quite necessary and important for industrial designers. Tests such as Torrance Test of Creative Thinking (TTCT), the Alternative Use Test (ALT) and the Remote Associates Test (RAT) are widely used means to evaluate creative ability all over of world. These tests, as well as creativity in general, require some form of communication for the creativity to be perceived. Therefore language ability should play a role in the perception of written or verbal creativity. Although there have been a lot of discussions and considerations about the impact of cultures on creativity, the data on comparing the effect of language mastery on creativity ability is limited. This paper aims at exploring the possible effect of language ability on creativity assessment through two studies. The first study was conducted in a university classroom in the United States comparing *English as Second Language (ESL) and Native Speakers of English (NSE)* students and the second study was taken in a university classroom in China.

## 2. Review of the Literature

### 2.1 Creativity as Seen from Different Perspectives

Over the past 35 years, studies of social and environmental influences on creativity have increased, these studies involved human psychology, education, business, culture and beyond (Amabile & Pillemer, 2012). It is believed that the basis of creativity is the ability to make non-obvious connections between seemingly unrelated things (Mednick,

1962; Martindale, 1999; Koestler, 1964). The process of creative thinking is often a mysterious phenomenon, in which insights seems to work at an unconscious level (Angela, 2008) and many academics try to better understand it. Creativity has been researched from a wide range of perspectives including behavioral psychology, social psychology, psychometrics, cognitive science, artificial intelligence, philosophy, design, and business (Leikin, 2012).

According to social psychologists, social environment can significantly influence an individual's motivation for doing an activity, which in turn can significantly influence creative performance. This is the intrinsic motivation principle of creativity, which defined as the drive to do something for the enjoyment, interest, and personal challenge of the task itself, is conducive to creativity (Hennessey & Amabile, 2010).

Hennessey & Amabile (2010) illustrated that Kaufmann (2003b) argued that the concept of creativity has been too loosely defined. He called for a clear-cut distinction between novelty on the stimulus and novelty on the response as well as a new classification of different kinds of creativity and intelligent behavior, including proactive and reactive creativity. Kaufman (2007) also put forward the study of "Big C" (eminent) creativity (relatively rare displays of creativity that have a major impact on others) and "little c" (everyday) creativity (daily problem solving and the ability to adapt to change), it is also essential to explore what might be termed "mini c" creativity, or the creative processes involved in the construction of personal knowledge and understandings. (Hennessey & Amabile, 2010)

Implicit theory of psychological concepts is also a consideration when addressing creativity. According to Oades-Sese & Esquivel (2011) implicit theories of creativity are beliefs and expectations held by parents, teachers, schools, and communities that determine whether a particular behavior or characteristic would be deemed as creative and therefore may elicit or inhibit certain creative behaviors. Implicit theories reflect cultural values, traditions, beliefs, and norms. Although implicit theories are hardly ever discussed, they have significant impact on people's daily lives. Parents will foster certain creative behaviors as well as teachers with their students. Thus knowing implicit theories is very useful in understanding the commonalities and differences that exist in how creativity is perceived across diverse cultures and how individuals judge and assess

whether traits or behaviors are considered creative.

Some cultures place most value on creative products, whereas others see creativity more as a process. Oades-Sese & Esquivel (2011) concluded that Westernized (e.g., European, Soviet-Russian) views of creativity are generally associated with novel and innovative ideas or products, while other cultures (e.g., German) value the creative process itself, and some emphasize the practical application of creative solutions to simple everyday life problems or complex societal problems (e.g., Latin Americans, Turks).

Research in the United States remains limited in understanding creativity among culturally and linguistically diverse individuals. However, more and more research is beginning to put emphasis on examining bilingualism and linguistic with cognitive style diversity in relation to creativity (Oades-Sese & Esquivel, 2011).

#### 2.1.1 Definition and Classification of Creativity

Although creativity is widely acknowledged and manifested a universal human experience, its definition and its focus vary in different cultures. According to Fryer's (2011) investigation and analysis, the cultural tradition of creativity in Australia is regarded as the first step in the process of innovation – something which probably links to early European settlers who had to invent out of necessity. Most Australians, however, would link creativity with art and culture rather than novelty. Among the traditional rural and semi-urban people, creativity is perceived as the skill to create artifacts which may not be original. To the urban educated, most people believe that creativity means novelty and originality. In Malta, people value creativity as an educational goal and trait. In Poland creativity is valued especially by educated people and by managers of large corporations, in which it is often a core value. In Romania creativity is a social and individual phenomenon and as an area of study. It is an education goal. In Spain, creativity is understood as the ability to find solutions for difficult problems and to make artistic works. In Singapore the term “creativity” includes innovation, entrepreneurship, invention, design, and development to come up with new possible solutions. In the United Kingdom, creativity has traditionally been associated with arts and been taken in higher education.

Thus it is not easy to give creativity a unanimous and consensus definition. In many languages there is more than one word to denote creativity. In English language, for example, there are many overlapping features between the words “creativity” and “innovation” and they tend to be used interchangeably. Chinese have “chuang zao” and “chuang xin”, the two phrases share the same meaning in much the same way as creativity and innovation. Even when the definitions are the same, there is often variation in how different elements are valued or prioritized over one another.

Most definitions, using the creative product as the distinguishing sign of creativity, propose that the general qualities of novelty and appropriateness differentiate creative from uncreative products (e.g., Barren, 1955; Bruner, 1962; Newell, Shaw, & Simon, 1962; Stein, 1974). In other words, the product or response must be unusual, unique, statistically infrequent, or completely unique, and it must also be correct in the context of the problem (Amabile, 1982).

Generally, creativity can be searched and explored from two different aspects, that is, creativity of products and creativity of persons. According to Hennessey and Amabile (2010) the creativity of products is typically the focus of experimental paradigms, and various conditions are quite important in assessing individuals’ creativity. The creativity of persons is typically case studies, or questionnaire-based investigations that operationalize creativity as a relatively enduring and largely stable personality trait. As early as 1982, Amabile pointed out that a product-centered operational definition is most useful for empirical research in creativity.

Individuals, who work in creative ways or in their different specialized fields, employ creative problem-solving techniques and procedures when they are facing with problems, can be regarded as creative people. Creative people can be found in various professions, different jobs categories, including engineers, scientists, architects, educators, artists, writers, and entertainers, etc. It is believed that the following three characteristics are normally associated with creative people: “self-confident, independent in thinking, and curious” (Benedict, 2014). Creative people tend to produce new ideas. In their eyes, a problem becomes a joy, and the situation that was once a problem has become something completely different and they will view them as a challenge or an opportunity. The creative people receive joy from solving these

problems (Benedict, 2014).

Hennessey and Amabile (2010) also made a distinction between divergent thinking and convergent thinking. According to them divergent thinking mode is an obvious feature of people with creative talent. Divergent thinking represents the instant and free style thinking for generating different ideas in a short amount of time. Convergent thinking means more narrowing the possible solutions to a certain degree. Compared with convergent thinking, it can be said that divergent thinking is rare and even more valuable to individuals.

### 2.1.2 Cases of the Effect of Creative Ability

The creative ability is often defined as one of the essential abilities in the society development. In a study of 1500 middle school students those who have high scores in creativity tests had more confidence about their future and ability to succeed (Po, 2010). Researchers found that people think creativity is the most important ability for main executive managers of corporations, since a creative vision of its leadership will make a great impact on the company's success (Noriko, 2001). A recent IBM Poll of 1500 CEOs identified creativity as the No.1 leadership competency of the future (Po, 2010). Previous researcher discussed the importance of creative ability in school, finding that learning outcomes are in parallel with the process of creative thinking (Noriko, 2001). It suggests "Students who use content in creative ways learn the content well. They also learn strategies for identifying problems, making decisions, and finding solutions both in and out of school" (Noriko, 2001). Lastly, in daily life, creativity makes a great impact on the capacity to respond effectively to novel problems and unfamiliar situations (Cynthia, 2013). Most studies agree creativity is a valuable ability.

### 2.1.3 Cultural Differences in Creativity

Most researchers and scholars agree that one of the most widely recognized differences between cultures relating to creativity is that of individualism vs. collectivism. Benedict (2014) made this clear in his book *Creativity* with a direct citation of Hofstede:

*"Individualism pertains to societies in which the ties between individuals*

*are loose: everyone is expected to look after himself or herself and his or her immediate family. Collectivism, as its opposite, pertains to societies in which people from birth onward are integrated into strong, cohesive in-groups, which throughout people's lifetimes continue to protect them in exchange for unquestioning loyalty" (p.251).*

Collectivism is most typical of Asia and the East. Confucianism is manifested in an emphasis on harmony, socio-centric thinking, self-sacrifice, a strong work ethic, and respect for elders and those in authority positions. Generally, harmony may lead individuals to conventional behavior, whereas independence might more easily lead to unconventional and creative behavior. Benedict (2014) made a further explanation in *Creativity* with a direct citation of Burke:

*"The medieval Chinese were without a doubt the most fruitfully inventive people on Earth. However, the fact that the technology of the modern world is Western shows to what extent the two cultures were different at time vital in the history of the effects of innovation on society. In the stable, civilized East the innovations were not permitted to bring about radical social change as they were in the brawling, dynamic West. The chief reason for this may have been the stultifying effects of Chinese bureaucracy .... There was no drive for the individual to use technology to improve his lot and so rise in the world, because rising in the world was out of the question" (p.252-253).*

Benedict (2014) pointed out that Bureaucracy can undermine the creative attitude, but values are central in whatever culture. Values allow certain personalities and inhibit others. Values dictate developmental experiences and parenting practices, as well as educational emphasis and personal development.

Many social psychologists described Eastern or Asian society as hierarchical, tightly organized and collectivist. There is an emphasis on social order, harmony and gaining approval. Traits such as being courteous and socially competent have been more associated with noncreative behaviors. Oades-Sese & Esquivel (2011) pointed out that westerners are individualistic and egalitarian, encouraging open and democratic exchange of ideas between individuals to develop creative potential.

Different cultures value and foster varying skills, thus different talents are encouraged in different cultural contexts and different cognitive skills are mastered that are adaptive to a particular environment and culture that for being considered creative. (Benedict, 2014). For example, Asian countries tend to have very different cultural and educational environment as compared to the United States (Noriko, 2001). Mistry and Rogoff (1985) found that the Eskimos have developed keen figural abilities to meet the demands of hunting. They extended this line of thought to the development of talent.

According to Hussain (Fryer, 2011), the West relies on a scientific approach of hypothesis building and the search for evidence; the traditional Eastern system, however, places great emphasis on building a solid foundation and basic knowledge step by step through rote learning ----- something which he believed has “*robbed people of the initiative to make bold hypotheses about new situations and new problems.*” He also pointed out that in Confucian-influenced societies, such as China, Taiwan, Singapore, Malaysia, and to some extent Japan, teachers are seen as the master of knowledge who must be respected, and challenging their views can be seen as inappropriate.

Hussain at the same time highlighted the incredible creativity and inventiveness of Chinese society as well as the outstanding works of great thinkers like Confucius. Despite all these achievements, he suggested that there have been no similar breakthroughs in the last 1000 years. He ascribed this fact to a lengthy period of feudalism. He contrasted this with a much shorter period of feudalism in Europe followed by the Renaissance, and later the Industrial Revolution. Hussain concluded that the historical conditions in the West over the past few centuries have been very favorable to creativity and inventiveness, whereas in the East the historical conditions have been less favorable. Hussain also pointed out that the Western emphasis on individual achievement over collective effort has its disadvantages, since it can spur people on to greater accomplishments; it results sometimes in self-centred individualism which will indirectly affects creativity (Fryer, 2011).

In *creativity* (2010) Hennessey & Amabile pointed out that Zha and his colleagues (2006) explored individualism/collectivism and the impact of culture on creative potential. In this study comparing highly educated American and Chinese adults, Americans displayed significantly higher scores on a measure of creative potential.

Chinese study participants showed significantly higher skill mastery in mathematics; as expected, Americans showed greater individualism, whereas the Chinese were more collectivistic (Hennessey & Amabile, 2010).

Fryer (2011) cited Lee's *Creative Malaysians* in his article as an example to analyze the influence of culture on creativity. He said that Lee provided a series of examples of creative people in Malaysia and other countries in South East Asia. Lee argued it is too simplistic to assert that Asians are less creative than Westerners. It is inappropriate to assume that any cultural factor is necessarily effective in judging or assessing creativity because some factors are unfavorable even inhibitive to the cultivation of creativity. This is especially true of those factors that are described as inhibitive (Fryer, 2011).

Thus, it is too simplistic to conclude that Western people are more creative than Eastern people or certain culture is more superior to the other culture in divergent thinking skills. Each of us is indeed a product of culture. With regard to cross-cultural assessment of creativity, cultural environment and disciplinary fields (music, mathematics, literature etc.) are indispensable elements (Benedict, 2014).

It is also important to keep in mind that although group averages and tendencies may differ dramatically between eastern and western world, there are some people within each group that can be more typical of the other group (Benedict, 2014). For example, some people in the individualism culture tend to be shown as collectivism features, like having conventional and traditional methods in solving problems.

Therefore, the aim is not to 'identify' the ability according to one set standard of what it means to be creative (e.g., high intelligence), since individuals possess diverse creative abilities. It is necessary to access in suitable manner the diversity of creative abilities according to a variety of domains (e.g., visual and spatial, kinesthetic, mathematical).

Many of the measures of the creativity tests used in the past have had their origins in the West. Benedict (2014) pointed that creativity test designers should be aware of the cultural differences and make their efforts to develop a "culture-free test" or at least "culture-fair tests."

#### 2.1.4 Measurement and Criteria of Creativity



In previous studies, creative process has been evaluated from different aspects, such as divergent thinking, problem solving, fantasy, imagery...*etc.* processes (Oades-Sese & Esquivel, 2011). Individuals prefer their own way to be considered as creative. For example, some are more creative in cooperative learning situations than in situations that are more competitive and some likes to solve problem in a systematic measure while others like intuitive approach (Oades-Sese & Esquivel, 2011).

Although some cultures have similar aspects towards how creativity is conceived, measure and developed, still it has some specific talents on how it is expressed and performed. Different cultures value creativity in different domains and behaviors. Some cultures place most on creative products, whereas others see creativity more as a process. The majority, however, have relied upon creativity tests—instruments that are usually similar in form and administration to conventional intelligence tests (Amabile, 1982).

Creativity can also be measured and evaluated by different tests for different purposes. According to Kharkhurin (2009) creativity tests include divergent thinking test (the Abbreviated Torrance Test for Adults) and structured imagination test (Invented Alien Creatures task). Divergent thinking is a kind of spontaneous, free-flowing thinking with the goal of generating many different ideas to a problem or situation in a short period (Guilford, 1967). It involves a board searching of information and generating of numerous of alternative answers or solutions to that problem (Guilford, 1967). The findings of the divergent thinking test revealed that bilingualism facilitates the innovative capacity and the ability to extract novel and unique ideas, but it doesn't foster the ability to generate and process a large number of unrelated ideas.

Although there are differences about the definition on creativity, the common criteria for defining and assessing creativity identified by Jackson and Messick (1965) has been widely accepted, that is, “novelty, transformation, condensation, and appropriateness” (Fryer, 2011). According to Lee, the characteristic of transformation was elaboration, meaning creative people tended to improve or working on the existing products rather than transforming them into completely new ones. Jackson and Messick described condensation as “the capacity to allow continued contemplation without exhausting meanings and implications.” This criterion seems more appropriate for works of art,

music, literature or making products by hand, rather than for innovation (Fryer, 2011).

## 2.2 Types of Creativity Assessment

Although creativity is manifestly a universal human experience, it is important to study how and to what extent culture influences its expression. All kinds of creativity tests can be traced back to J. P. Guilford, who addressed the American Psychological Association in 1950 that dig into creativity as a cognitive and social process (Amabile & Pillemer, 2012). E. Paul Torrance, who combined the insights such as architecture, mathematics and creative writings into practical use in the creativity field, developed the Torrance Test of Creative Thinking; Amabile (1982) put forward the Consensual Assessment Technique (CAT), which is another method to examining social and environment effects on creativity. The CAT is started from a consensual definition of creativity and is open-ended to allow for non-special skills to be considered as creative ability (Amabile & Pillemer, 2012).

A large number of the creativity studies are based on experimental creativity tests, since the data can be properly and easily analyzed by administrators. Some of the more common creativity tests include the Torrance Test of Creative Thinking (TTCT) by Paul Torrance (Torrance, 1972), the Remote Associates Test (RAT) by Sarnoff Mednick (Mednick, 1962) and the Alternative Use Test (ALT) which is a divergent thinking test by Joy Paul Guilford (Guilford, 1956). These creativity tests correlate with tests of divergent thinking and convergent thinking, which are less abstract cognitive process. These techniques have been used reliably in a large variety experimental designs which across multiple ages and skill levels for many years.

### 2.2.1 TTCT

Torrance Tests of Creative Thinking (TTCT) (1974) is by far the most commonly used standardized measurement tool of creativity and divergent thinking. It is has been administered to millions of people in 50 languages worldwide (Po & Merryman, 2010). It is a pragmatic method of testing in which researchers or the publisher can assess the test. The rich history of the TTCT provides a substantial database of responses collected over years.

A variation of the TTCT is the Abbreviated TTCT for Adults, which includes three 3-min tests. The first activity asks the participants to list as many different consequences as they could think of using a given hypothetical circumstance. An example question used in the study was “Just suppose you could walk on air or fly without being in an airplane or similar vehicle. What problems might this create?” The second activity asks the participants to complete two incomplete figures and provide titles for the drawings. The third activity asks the participants to sketch as many different objects as possible using nine blank triangles (Goff & Torrance, 2002).

The TTCT is scored on four criterion components of creativity: 1) Fluency - the number of responses given by the participants. 2) Originality - unique responses provided beyond a common list of responses. 3) Elaboration - amount of embellishment of the ideas with details. 4) Flexibility - the variety of the responses. In addition to these subscale scores, the TTCT provides scores on 20 creative strengths including: emotion, humor, unusual visualization, and abstractness of titles. Each of these creative metrics is based on a review of the entire TTCT. The TTCT creativity Index (CI) is the composite score on the test and serves as “an overall indicator of creative potential” (Torrance, 1992). Torrance was one of the pioneers in recognizing that creativity can be understood and measure by scientific methods (Sternberg, 2006).

### 2.2.2 The Alternative Uses Test (ALT)

The Alternative Uses Test (ALT) or “Unusual Uses Test” was created by J.P. Guilford in 1967 and is perhaps the most cited of his tests. It is also the most widely used test in psychometric and experimental studies of creativity (Gilhooly & Fioratou, 2010). Guilford first proposed that it is possible to study and evaluate creativity of subjects using a psychometric approach (Sternberg, 1999). The Alternative Uses Test is specifically a method to evaluate divergent thinking which most researchers agree is a critical component of creativity (Sternberg, 1999). The test requires participants to generate many possible uses for common objects such as a brick, a newspaper, and a cardboard box (Guilford, 1971). This test is a measure of “spontaneous flexibility” (Guilford, 1956), which is one of the four criterion components adapted by Torrance: fluency, flexibility, originality and elaboration.

Alternative Uses responses are evaluated by the following components which are similar to TTCT scoring system: 1) Fluency, the number of answers given by the participants. 2) Originality, uncommon when compared to the overall data set. 3) Elaboration, embellish ideas with different details. 4) Flexibility, processing objects in various categories.

### 2.2.3 RAT

The Remote Associates Test (RAT) was formed along with the associative theory of creativity, which claims that creative thinking ability involves developing of associative elements into new combinations or objects that meet specified requirements (Mednick, 1962). The first form of the RAT was developed at the Institute of Personality Assessment and Research (Mednick, 1962). It has been used with college undergraduates, graduate students, and various professional groups.

The RAT involves finding a connective link word between sets of three seemingly unrelated words that have a mutually remote association or meaning. The subject would be required to find the word that serves as a connective link, which can be paired with any of the three words in the set. There is only one allowable solution for each set of words. An example of a set of words could be: tap rain floor. The word “dance” connects with the three words in the forms of “tap dance,” “rain dance” and “dance floor.” The test is constructed to involve both divergent thinking and convergent thinking (Sarnoff, 1965).

## 2.3 Foreign Language Ability and Creativity

### 2.3.1 The Effect of Bilingualism on Creativity

Language ability and skills have shown to improve the academic skills, cognition, mental, cultural characteristics and creativity of a person (Papadopoulos, 2014). Several studies have demonstrated significant influence of bilingualism on divergent and convergent thinking ability (Leikin, 2012). The advantages of bilingualism of a person have been seen across a variety of domains, such as creativity (Bruck & Tucker, 1976), problem solving (Adesope, Lavin & Thompson, 2010) and perceptual cognition (Duncan & De Avila, 1979). It has been reported that the performance of a balanced bilingual is better than that of their monolingual peers on tests assessing general

creativity and flexibility as well as on conception formation (Kessler & Quinn, 1987). Balanced bilingualism performed almost equally well on both the languages they mastered. Another study found that bilinguals scored higher than monolinguals on originality and flexibility elements in verbal creativity tests, and on originality and fluency elements in figural creativity tests (Mark & Esther, 2014). The degree of bilingualism in general was found to positively relate to creativity (Hangeun & Kim, 2011). It is believed that bilingual students develop more comprehensive and coherent thinking skills (Papadopoulos, 2014). Research in psycholinguistics also points to a strong link between bilingualism with affective, cognitive, and creative processes (Oades-Sese & Esquivel, 2011). When civilizations were composed of multilingual cultural groups rather than only one cultural, the potential for creativity will thrive (Simonton, 1999)

Researchers have also found a relationship between bilingualism and intelligence. When students are introduced to a new language through courses in a second language, they could present a greater cognitive and linguistic flexibility (Eckstein, 1986). Bilinguals have also developed more flexibility in thinking and tend to have higher intelligence (Elizabeth, 1962). More intelligent children may realize the value of knowing English in addition to their native language and therefore seek opportunities to learn it. Studies have shown that students whose first language is Greek immerse themselves in English environment could better enhance the verbal and nonverbal expression of English (Papadopoulos, 2014). When children show progress in learning English, their parents may give them greater encouragement to learn new things and take on other challenges (Elizabeth, 1962). People become active members with higher level and critical thinking skills and ability to evaluate in a new situation (Byram, 2000). It is possible that creative differences in ESL and NSE groups are a result of differences in educational experience, family expectancy, sociocultural forces and cultural background.

Numerous researchers of ESL have explored how individual differences help account for variation in ESL learning task performance (McDonough, 2015). Researchers have explored a wide range of critical factors that may be implicated in work performance and communication of ESL (McDonough, 2015). For example, researchers have compared the creative performance of young American children with

children from other cultures (Ogawa, 1991). This study found no cultural differences on the fluency scores of the creativity tests, but American children appeared to be superior to Japanese children in flexibility scores. Researchers suggest that the differences might appear in the children's different education and living circumstances (Noriko, 2001).

### 2.3.2 Advantages of NSE

There are other studies involving ESL and American NSE adults in performing the TTCT creativity test. A study of American college students who are all NSE and Japanese college students who are all ESL found that NSE students showed significant and meaningful higher creativity score in TTCT than the ESL students (Noriko, 2001). The researchers concluded that the higher creativity scores of American students may be a result of their culture fostering creative ability. In other words, the NSE students have more opportunities to foster their creativity in their education and family circumstance than ESL students. There have been a few similar studies finding cultural differences favoring American students over Koreans (Kim & Michael, 1995). Kim and Michael (1995) found that in Korea, conformity to others or their elders provide less opportunity for creativity development, which is different from Americans where independence and individualism is encouraged in the education system.

Prior studies have also revealed a positive relationship between the ESL students' creativity and their performance on a group problem-solving task by using TTCT booklet as an evaluation (Kim & William, 2015). The positive findings for questions and coordination suggest that creativity may help in how ESL learners interact with others during problem-solving tasks. This finding is consistent with the Hungarian ESL context reporting links between creativity and class grades and features of narrative task (Albert & Kormos, 2004).

Although there have been many cross-cultural studies on creativity with comparison of an ESL group and an NSE group, little is known about whether these differences are related to language ability. Environmental factors could be a factor in the difference in creativity between cultures, but little research has been done in comparing creative performance of the same ethnic group when modifying the language in which the test is given. The research questions addressed in this study are as follows:

1. Is there a positive relationship between English mastery and creativity ability (as measured by the TTCT, ALT and RAT) for ESL students?
2. Is there a significant difference between ESL group and NSE group in their creativity ability when taking these creativity tests in English?
3. Will ESL students perform better in creativity tests with their native language than with English?

### **3. Experiments**

#### 3.1 Method of Test

This study consists of two experiments: one correlational and one comparative.

The correlational study involved a university class of students in the United States in different majors with various native language backgrounds (both ESL and NSE). The independent variables are the English ability of students and the dependent variables are the TTCT, ALT and RAT score of the students.

The comparative study was conducted to investigate whether a relationship exists between performance on creativity test (TTCT) and the language used in the test (native or English). This experiment was conducted with Chinese students in public university in China. For the comparative study, the only variable is the language of the TTCT test booklet/responses: one group of Chinese students using their native language and the other group students using English.

#### 3.2 Experiment 1

##### 3.2.1 Method and Participants

The participants for the correlational study were 161 American university students with English as their native language and 33 international students with English as their second language. This experiment has involved different majors in the university. All the 194 participants were recruited for the study from an interdisciplinary creative design methods class in which TTCT, ALT and RAT is not included in their final grade and administered on the first day of class. The experiment was conducted during normal class time.

### 3.2.2 Instrumentation and Procedure

Three tests were administered. The Abbreviated Torrance Test for Adults (ATTA), the Alternative Uses Test and the Remote Associates Test. The time limit per activity was strictly followed in order to utilize the normative-based interpretations (Goff & Torrance, 2002). The first exercise asks the respondent to suppose that if he or she could fly on air, and write problems or troubles that may occur and encounter. The second exercise provides two incomplete figures to complete into interesting pictures with titles. The third exercise asks respondents to transform a group of triangles into pictures with titles. The scoring booklet combines scores of each of these components into a Creativity Index (CI) in which a score of 78-84 is deemed highly creative and 68-73 is the U.S. average. The CI of more than 85 is treated as substantial.

The Alternative Uses Test theme was paperclips and participants were given 3 minutes to list as many different uses as possible. Scoring of this test was simply a count of items listed as prior research has shown this to be a strong indicator of creative performance (Dippo & Kudrowitz, 2013).

The Remote Associates Test consisted of 30 word-triads and participants were given 15 seconds to respond to each triad that was presented on a screen. Scoring on this test was simply a count of correct responses. In our study, all the participants were given 30 triads of words with each triad of word in 15 seconds to respond. Productions were scored for quantity, which is the number of acceptable and correct answers. The correct answer meaning they found the fourth word that makes sense with each of the three words in the triad.

The subjective self-rating of English ability of each participant was conducted before the TTCT, ALT and RAT were administered. Subjective self-rating of English ability was on a Likert scale of 1 to 10 with 1 being low and 10 being high.

The TTCT, ALT and RAT were all administered following the instructions in the manual. All the 194 participants (33 ESL students and 161 NSE students) were given these three tests individually. After testing, all the test booklets were scored by trained researchers aware of the creativity study. Participant names were not viewed while grading. The researchers provided the group and individuals with score results after grading.



### 3.2.3 Results

Table 1 provides the means and standard deviations for scores on the TTCT, ALT and RAT of ESL and NSE students in the university class. A t-test was conducted on the TTCT Creativity Index to examine whether there is a significant difference between ESL and NSE using an alpha=0.05 through the study. The results of the t-test analysis found a statistically significant difference ( $F=0.055$ ,  $P=0.002$ ), with the NSE students' scores being higher. As the population sizes of ESL and NSE are significantly different, a bootstrapping was performed. Figure 1 shows the results of this bootstrapping in which a statistical significant difference relationship still exists.

Table1. Means and Standard Deviation on Scores of ESL and NSE

	ESL		NSE		F	Sig (2-tailed)	Sig	t
	Mean	SD	Mean	SD				
TTCT	75.15	8.03	79.66	7.43	0.06	0.002	0.82	-3.13
ALT	9.82	4.56	13.23	4.86	0.15	0.000	0.70	-3.17
RAT	6.67	4.42	12.08	3.35	6.24	0.000	0.01	-7.99

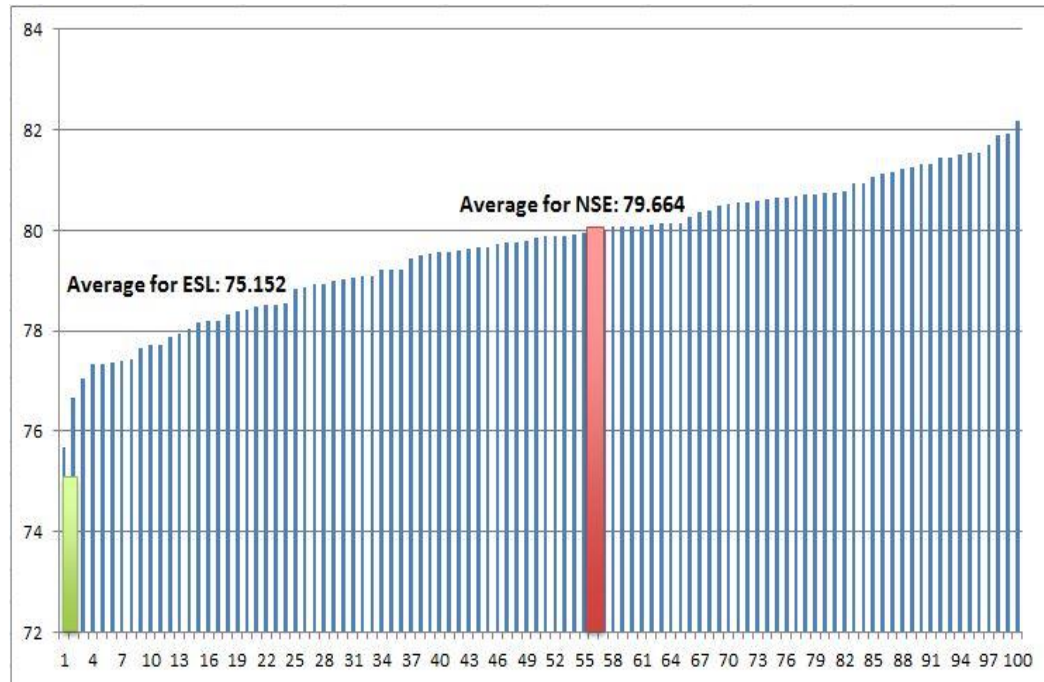


Figure 1. Bootstrapping of TTCT Score Between ESL and NSE

To determine whether language was contributing to the significant difference of TTCT score between ESL and NSE, a Pearson Correlation study was computed using the self reported English ability Likert scores. Since students report their English ability in different levels and each level has a different quantity of students, the mean score of TTCT was calculated within every English ability score level and analyzing the Pearson Correlation. All ESL students reported their English ability level between 5 and 10. For 5(n=1), 6(n=3), 7(n=8), 8(n=7), 9(n=3), 10(n=11). There was a moderate linear correlation between TTCT scores of ESL and their English ability. Table 2 shows the result that  $R(31)=0.721$  and  $P\text{ value}=0.106 > 0.05$ .

Table 2. Correlation Analysis of Scores and English Ability of ESL

ESL (N=33)				
Components	Multiple R	R Square	Standard Error	P Value
TTCT	0.721	0.519	2.317	0.106
ALT	0.856	0.732	2.346	0.029
RAT	0.933	0.871	1.316	0.006

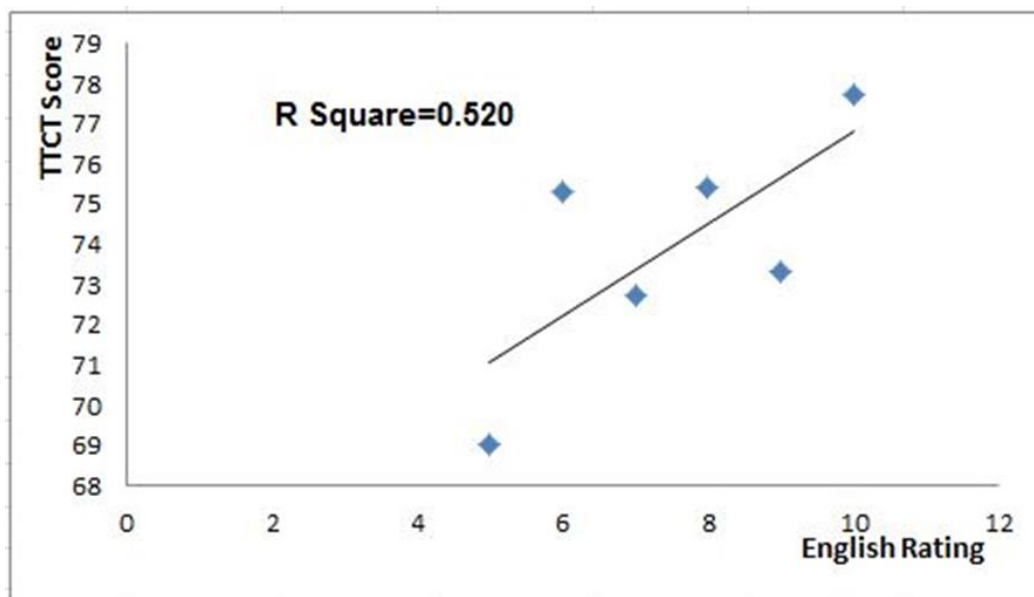


Figure 2. The R Square of TTCT and English Ability of ESL

Another T-test was conducted to test if there exists a significant difference of ALT score between ESL and NSE students. Table 1 shows the mean and standard deviation of ESL and NSE on the ALT. There exists a strong significant positive difference relationship of ALT score between ESL and NSE students with NSE score higher on the average score ( $F=0.146$  and Significant (2-tailed)  $=0.000 < 0.05$ ).

The Pearson Correlation was computed to test whether English is the component that contributes the significant difference. Like the TTCT, the ALT was calculated within every same English ability score and analyzing the Pearson Correlation. The bootstrapping was performed as well in Figure 3. There is a statistically significant linear correlation relationship between ALT score of ESL and their English ability. Table 2 shows that  $R(31)=0.856$ ,  $P=0.0297 < 0.05$ .

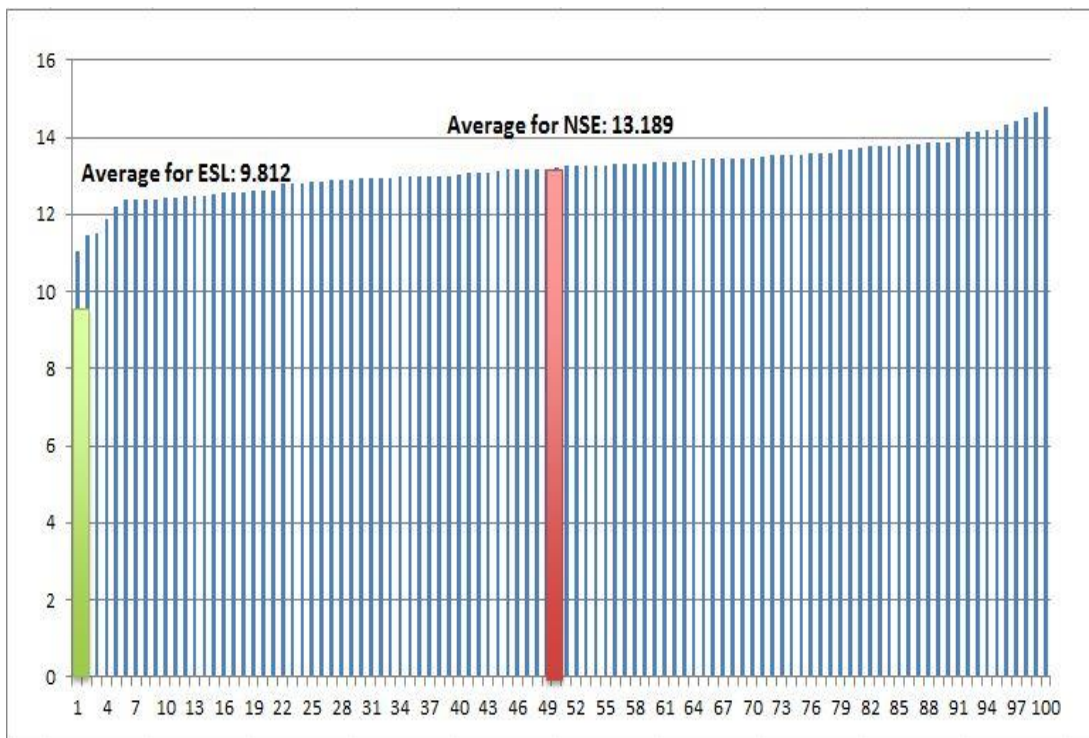


Figure 3. Bootstrapping of ALT Score Between ESL and NSE

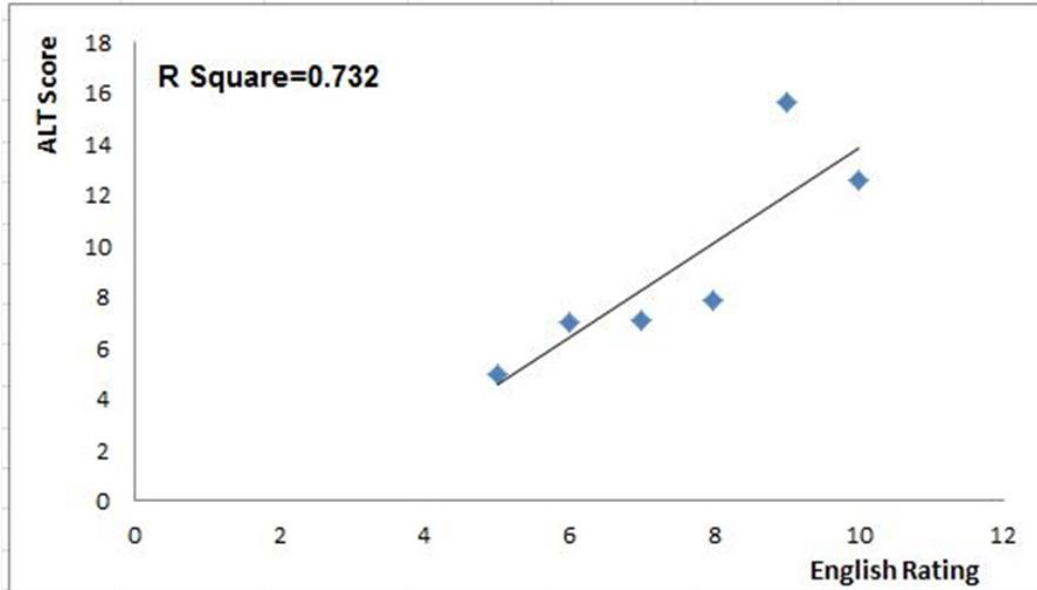


Figure 4. Trend Line of ALT Score and English Ability of ESL

Another t-test was conducted to confirm that RAT score has a significant difference between ESL and NSE in class. With the  $F=6.236$  and  $P=0.000 < 0.05$  shown in Table 1, NSE students had a higher score on the RAT test. The bootstrapping was also performed for accuracy in figure 5.

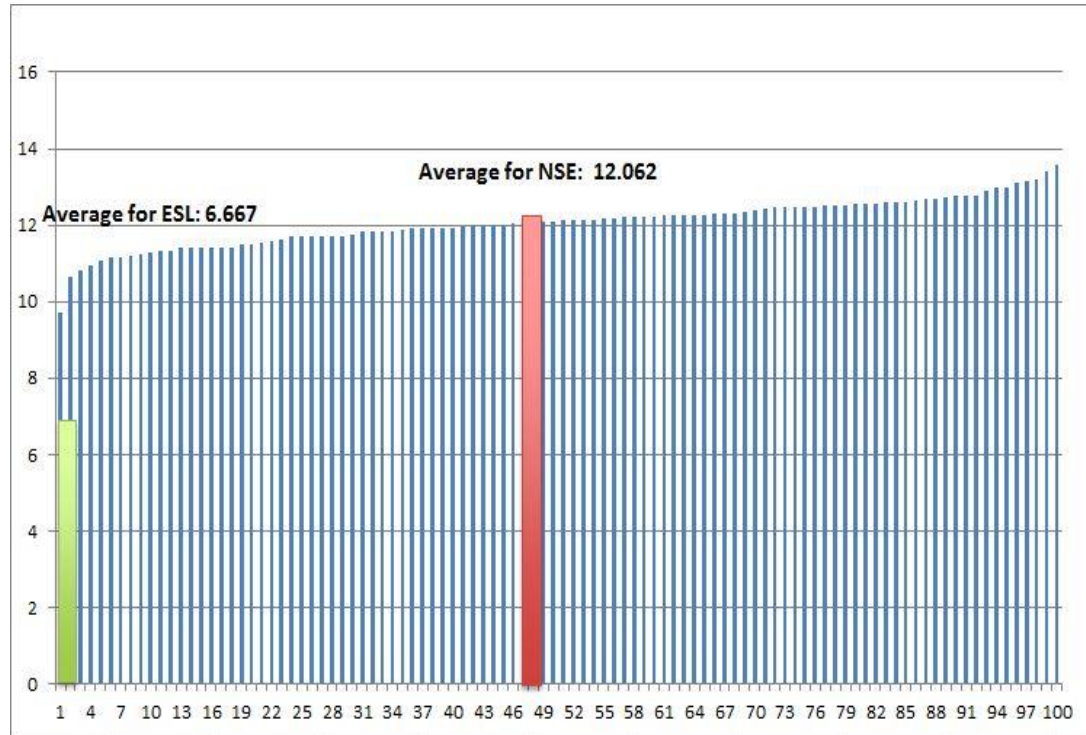


Figure 5. Bootstrapping of RAT Score Between ESL and NSE

The Pearson Correlation was also computed to test whether English is the component that contributes this significant difference of the RAT score. The mean score of RAT within every same English ability score were also conducted to test the difference. There is a statistically significant linear correlation relationship between RAT score of ESL and their English ability. Table 2 shows that  $R(31) = 0.933$ ,  $P = 0.0065 < 0.05$

The Pearson correlation analysis which was applied in experiment one is a measure of the strength of the linear relationship between two variables. It could also refer to as correlation coefficient. If the relationship between the variables is not linear, then the Pearson correlation does not adequately represent the strength of the relationship between the variables.

The symbol for Pearson's correlation is "P" or "Sig (2-tailed)" when it is measured in the population. Since this study uses SPSS for sample analysis, we will use P to represent Pearson's correlation strength.

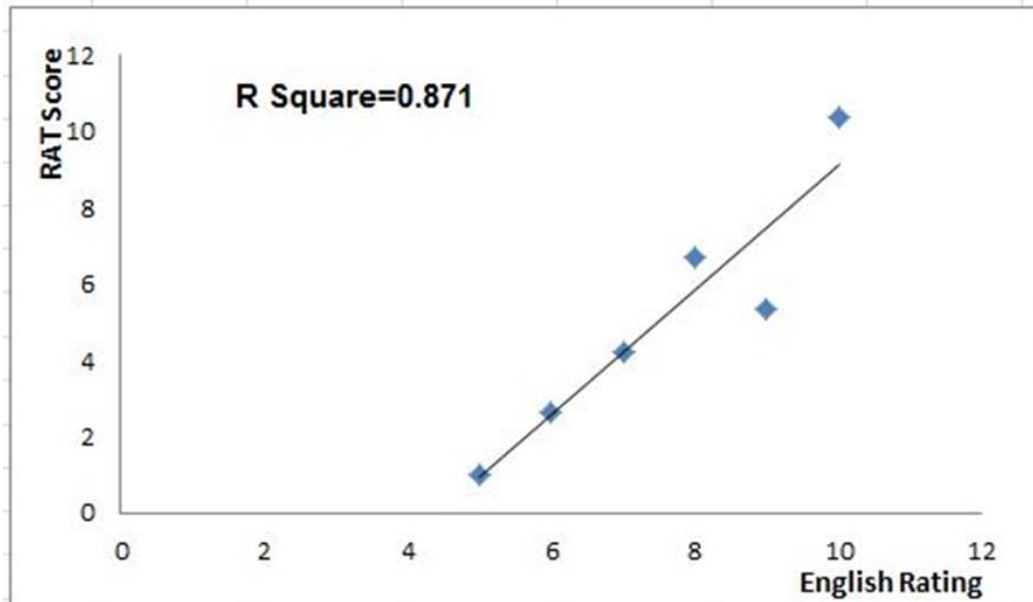


Figure 6. Trend line of RAT Score and English Ability of ESL

The critical point is 0.05. If Pearson's P value is less or equal to 0.05, it indicates a correlation between the two variables. If the P value is less than 0.01, it indicates a strong correlation relationship between the two variables. If the Sig P value is larger than 0.05, there is no correlation relations at all between the two.

The Pearson's r can range from -1 to 1. An r of -1 indicates a perfect negative linear relationship between variables, an r of 0 indicates no linear relationship between the two variables and r of 1 indicates a perfect positive linear relationship between variables.

### 3.3 Experiment 2

#### 3.3.1 Method and Participants

The participants for the comparative study were 146 Chinese public university students in China majoring in mechanical engineering, industrial design, English, math and aerospace engineering. All the Chinese participants were recruited for the study as volunteers. All of these participants are Chinese citizens with Chinese as their native language and English as their second language. The TTCT booklets were given to them and their subjective self-rating of English ability was asked to be written on the TTCT booklet cover before beginning the test. The English ability scale was the same as the

prior correlation study in which a score of 1 on a Likert scale indicates no understanding of English and 10 indicates fluency in English. Participation in the study was not required and had no impact on their class performance.

### 3.3.2 Instrumentation and Procedure

The Abbreviated Torrance Test for Adults was administered as the text for creativity. The TTCT was administered following the instructions in the manual. Approximately half of the 146 Chinese participants were randomly given the English version of the TTCT booklet and the others were given the Chinese version of the TTCT booklet. For the Chinese version of the booklet, an experienced translator translated all instructions into Chinese. There were a total of 76 Chinese participants taken the English version of the TTCT booklet and 70 Chinese participants taken the Chinese version. For following the guide, the three-minute limit per activity was strictly followed in order to utilize the normative-based interpretations (Goff & Torrance, 2002).

After testing, the test booklets were sent to trained researchers who are bilingual speakers of both Chinese and English for grading. Participant names were removed for grading. The scoring process was closely followed the TTCT manual.

### 3.3.3 Results

The statistical method used in this comparative study is T-Test, which is a means of hypothesis statistical examination of two groups. A two-sample T-test examines whether two samples are different and it is commonly used when the variances of two normal distributions are unknown and when an experiment uses a small sample size. The most commonly applied is that the test statistic would follow a normal distribution.

For the T-test, the data sample size could either be paired or not paired, which means the sample size of the two groups could be unequal. The value of the T-test could be used as P or Sig (2-tailed). If the Sig (2-tailed) value is less than 0.05, there exists a significant difference between the two groups. If the Sig (2-tailed) is larger than 0.05, there is no significant difference between the two sample groups.



Table 3. Means, Standard Deviations and P Value of English and Chinese Version of TTCT

components <sup>o</sup>	English Version (n=76) <sup>o</sup>	Chinese Version (n=70) <sup>o</sup>
Mean <sup>o</sup>	74.013 <sup>o</sup>	74.214 <sup>o</sup>
SD <sup>o</sup>	8.584 <sup>o</sup>	9.103 <sup>o</sup>
R square <sup>o</sup>	0.003 <sup>o</sup>	0.052 <sup>o</sup>
P value <sup>o</sup>	0.626 <sup>o</sup>	0.058 <sup>o</sup>
T-Test Sig(2-tailed) <sup>o</sup>		0.891 <sup>o</sup>
T-Test Sig <sup>o</sup>		0.941 <sup>o</sup>
T-Test F <sup>o</sup>		0.006 <sup>o</sup>

Table 3 is the t-test conducted on the TTCT creativity index to examine the effects of English language ability on creativity testing. The results of the analysis revealed no statistically significant interaction ( $F = 0.006$ , Sig (2-tailed)=0.891) of the two groups, using  $\alpha=0.05$  as the criteria. Although participants taking the test in their native language had on average 0.2 points higher on the TTCT, this is insignificant. A correlation study was also conducted to see whether there is a correlation relationship between the TTCT score and the self-evaluated English ability scores of the Chinese participants. The result of the analysis revealed no statistical significant correlation of the TTCT score and English ability score ( $P=0.626$ ,  $P=0.058$ ). When Chinese students completed the TTCT in their native language, the result was only 0.27% higher than the English version. A correlation analysis was conducted to see whether English ability correlates with Chinese participants' TTCT score separately. The Sig.(2-tailed)=0.63 for Chinese participants doing the English version and the Sig. (2-tailed)=0.06 for those doing the Chinese version.

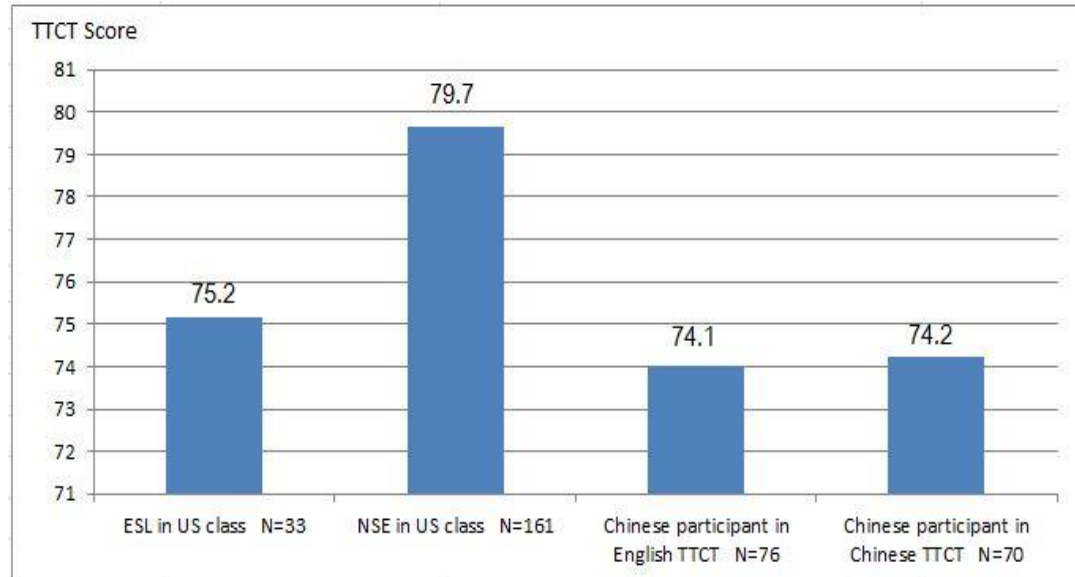


Figure 7. Average Score of TTCT of the Four Main Groups

To explore this further, we are interested to see how different the TTCT score is between the NSE students and the Chinese participants. Figure 7 shows the average TTCT score distributed in four different groups in this study. Note that the Y-axis starts at a TTCT score of 71 (as opposed to 0) as this is the National US average for the TTCT (Goff & Torrance, 2002). The NSE in the U.S. class have the highest average score among the total participation. The assessment of Chinese participants average score is considered “above average” and is where 20% of US adults are ranked Above Average (Goff & Torrance, 2002). By analyzing the relationship of NSE and Chinese participants score,  $F=4.319$ ,  $t=-5.989$ ,  $\text{Sig (2-tailed)}=0.000$  revealed that this United States class of NSE students have a statistically significant higher TTCT score than the Chinese participants in this study.

Since TTCT has verbal responses (activity 1) and figural responses (activity 2 & 3), another T-Test was conducted to compare whether there is a significant difference in scores of just the figural responses (ignoring the purely verbal activity 1) between ESL ( $n=33$ ) and NSE ( $n=161$ ). Through statistical analysis, there was still a significant difference on just figural scores ( $F=0.014$ ,  $\text{Sig (2-tailed)}=0.029<0.05$ ).

Table 4. Means, Standard Deviations and P Value of ESL and NSE in activity 2 and 3 of TTCT

components <sup>ϕ</sup>	ESL (n=33) <sup>ϕ</sup>	NSE (n=161) <sup>ϕ</sup>
Mean <sup>ϕ</sup>	32.879 <sup>ϕ</sup>	37.540 <sup>ϕ</sup>
SD <sup>ϕ</sup>	10.688 <sup>ϕ</sup>	11.199 <sup>ϕ</sup>
SE <sup>ϕ</sup>	1.861 <sup>ϕ</sup>	0.877 <sup>ϕ</sup>
T-Test Sig(2-tailed) <sup>ϕ</sup>		0.029 <sup>ϕ</sup>
T-Test Sig <sup>ϕ</sup>		0.905 <sup>ϕ</sup>
T-Test F <sup>ϕ</sup>		0.014 <sup>ϕ</sup>

## 4. Discussion

### 4.1 Language Ability and the Verbal Creativity Testing

In the first study, the NSE students showed a statistically significant difference and meaningfully higher scores on the TTCT creativity index, ALT and RAT test than the ESL students. Although self-assessed English ability was not directly correlated with TTCT, it was highly correlated with ALT and RAT scores.

The ALT and the RAT are both entirely verbal and this data suggests that they are correlated with language ability. Scores on these two tests should not represent the creative abilities of ESL individuals. The RAT was developed along with the associative theory of creativity, which claims that creative thinking involves forming of associative elements into new combinations that meet specified requirements. ESL individuals may not have the proper linking words in their vocabulary that are associated with the three seemingly unrelated words. This may be a result of their education or culture differences. The created compound words may be specific cultural references that would not be obvious to ESL individuals (such as “dating game” “girl scout” or “jelly bean”). There are similar concerns with the ALT, wherein the participants may lack the English words and meanings of advanced vocabulary to write the concepts that they are thinking.

One suggested reason why English ability does not significantly impact the scores of the TTCT is because the TTCT is two thirds visual as opposed to verbal (activity two and activity three). Activity one of the TTCT is verbal and requires writing, which is about listing problems rather than solving a problem. While drawing eliminates the dependency on language and vocabulary skills, ESL groups still has a significant lower score than the NSE groups in activity 2 and 3. This could explain that ESL group is less creative than the NSE group according to the TTCT. The verbal part of the test could influence ESL's performance in creativity ability and their figural parts of the test are still scoring less than the NSE group.

One suggested reasoning of why English ability does not significantly impact the scores of the TTCT is because the TTCT is two thirds visual as opposed to verbal (activity 2 and activity 3). Drawing eliminates the dependency on language and vocabulary skills. Activity 1 of the TTCT is verbal and requires writing, but is about listing problems rather than solving a problem.

TTCT does require titles with the pictures and so there may be difficulties in translating titles into English. This is especially difficult when the images are specific to Chinese culture including fantasy cartoon characters, fairy tales characters, science fiction and other fantasy literature. ESL individuals may choose to not include these potentially creative responses, as it would be too difficult to explain the idea and thus choose more common responses instead.

In the second study, the Chinese students taking the native language version of the TTCT showed a slightly higher average score than those who did the English version, but there is no statistically significant and meaningfully higher score on the TTCT creativity index. In other words, language ability does not appear to have a significant influence on scores of the TTCT for the Chinese participants. When comparing all the TTCT data in the two studies, the NSE students in U.S. class showed higher creative ability than ESL students on TTCT score. This finding is consistent with previous research (Noriko, Lani & Xiao, 2001), which revealed that American college students had statistically significant and meaningfully higher score on TTCT creativity index than Japanese college students.

## 4.2 Cultural Differences

It is possible that creative differences in ESL and NSE groups are a result of differences in educational experience, family expectancy, sociocultural forces and cultural background. For example, Asian countries tend to have a very different cultural and educational environment as compared to the United States (Noriko, Lani & Xiao, 2001).

As some foreign culture is based more on conformity, rather than individualism, students from those countries might be more inclined to seek conventional responses. Even though the test instruction asked respondents to “make one’s title as unique and unusual as possible, and to use the title to help tell one’s story”, the ESL students might be less experienced in showing their own unique ideas.

Looking closely at the ESL students responses for activity 1 in the TTCT, which were scored for richness and colorfulness, emotions, humor and provocative questions, one would find mostly common sentences lacking humor and colorfulness. As for activity 3, points are awarded for abstractness of titles and most ESL students tend to use generic titles instead of giving an abstract interpretation and going beyond the object itself.

Originality in TTCT is defined as generating ideas that have not been thought of before, or ideas that are new or unique. What is considered statistically unique in one culture may not be considered as such in another culture. Creativity is relative. A concept can be creativity to the individual or creativity to society (Boden, 2010). For example, American graders may feel a response is highly creative because it is unfamiliar, whereas a Chinese grader may feel it is obvious and thus not creative (Noriko, Lani & Xiao, 2001). Similarly with humor, which has been defined as a response that “is funny and makes you laugh and smile” (Goff & Torrance, 2002). Something considered funny in one culture may not be considered as such in another culture. Humor like creativity is relative.

Educational experience, family expectations, and socio-cultural forces could all have influence the creativity ability (Hangeun & Kim, 2011). This finding is consistent with previous research (Kim, & Michael, 1995), in which culture differences favors American students over Korean students. Kim and Michael noted that in Korea, or some

Asian countries, conformity to others and to the expectations of parents and teachers provide less opportunity for creativity to develop. While American culture values independence and individualism and risk challenging, some Asian cultures think conformity and collectivism are more important in everyday life (Hangeun & Kim, 2011). Previous research shows that more contact with English Canadians and English culture may account for a more favorable attitude and will foster idea generation (Elizabeth & Lambert, 1962). Creative people tend to be nonconforming, independent, intrinsically motivated, open to new experiences, and risk seeking (Angela & Maddux, 2008).

These creativity tests were developed by NSE Americans and they are perhaps testing qualities which are believed to be creative to Americans. It is possible that the fundamental elements of creativity are not universal and each culture has their own interpretation of creativity.

#### 4.3 Age and Environment

Individual's age and living environment has a great impact on one's foreign language ability, which in turn affects the result of TTCT they have ever taken. Although Chinese students who took TTCT in Chinese version showed a slightly higher average score than those who did in English version, there is no statistically significant and meaningfully higher score on the TTCT creativity index. In other words, language ability does not appear to have a significant influence on scores of the TTCT for the Chinese participants. This result is different from Istvan's research (1998), in which they found a highly significant correlation between the students' total scores on the creativity test and their English grades in Budapest, Hungary (Istvan, 1998). The reason could be that they tested the secondary school students in Hungary with an average of proficiency in English as younger learners, who had been learning English for less than one year. The difference in geographic environment and levels of English ability could cause the difference in result. The materials are also different from these two studies. Istvan (1998) uses the five subtasks (consequences, unusual uses, common problems, categories, and associations) all in Hungarian language, which is far broader than TTCT in this study.

And Istvan's (1998) study was taken in year 1998 with only 34 participants. Different time period and limited sample size could also cause the difference in results.

As no other language of TTCT studies have been conducted on mainland Chinese students before, it is unknown if the findings here are typical.

#### 4.4 Self-rating Report

In both of these studies, the self-rating of English ability may also cause the non-statistical difference results, since it is more subjective than taking a Standard English test. Different students have their own criteria for their English ability level. The score of 10 may mean different to ESL and NSE groups. Including a uniformed English test may be helpful as a validity check for providing a Standard English score before the creativity test was done. For this study, we compared some of the TOEFL scores of ESL students with their self-rating scale anonymously. There is no significant positive relationship between the two variables  $P=0.168>0.05$ , which means that the higher students get their TOEFL scores, doesn't necessarily lead to a corresponding higher self-rating scale they provided by themselves. This subjective and self-rating method could be factors that influence the accuracy of the study. Some ESL students were just visiting students for one term and some were graduated from an American high school, so we were unable to obtain their TOEFL scores at this time.

#### 4.5 The TTCT

Both experiments used the Torrance Test of Creative Thinking test sheet for evaluate students' creativity ability. However the TTCT has been the standards for assessment of creative thinking abilities since it was first published in mid 1960s, 50 more years have passed since it published and it could not be an ideal tool to test the creativity in nowadays. The test could be biased and in favor of certain culture groups or certain language groups, thus the TTCT could be a factor that influences participants' performance. More rational and utilized creativity test by involving real-life criteria need to be developed that can be led the current testing of creative behavior achievement.

## 5. Conclusions and Future Work

In the first study, the TTCT, ALT and RAT were used as measures of creative ability of 194 students. A self-rating of English ability was used as a first order measurement of language mastery. As hypothesized, the results indicated a significant difference in creative ability between ESL and NSE students. On the verbal tests, English ability of ESL students was positively correlated with scores (ALT,  $P=0.029$ ; RAT,  $P=0.006$ ). Alternatively, in the TTCT, which is partial verbal, there was no strong correlation between self-rating of English ability and creativity scores. However, ESL students in general had statistically significant lower TTCT creativity scores than NSE students ( $F=0.055$ ,  $P=0.002$ ). It was hypothesized that the language in which the test is taken is a critical factor. For the further study which we only compare the figural parts of the TTCT which is activity 2 and activity 3, the NSE still showed a significant difference than the ESL group ( $P=0.029$ ). If the language is the factor that influences the performance of ESL on the verbal part, then the drawing parts of the TTCT still limited the creativity performance of ESL. Thus, we may get to the conclusion that ESL group in the American class is less creative than the NSE group according the TTCT test sheet.

A second study of 146 Chinese students (ESL) was conducted in Xi'an, China. Approximately half of the students were given the TTCT in Mandarin; the other half was given in English. Disproving our hypothesis, there was no significant difference ( $F=0.006$ ,  $P=0.891$ ) in creativity scores, showing that English ability was not a critical factor in the TTCT. However there is a significant difference ( $F=4.319$ ,  $P=0.000$ ) when comparing TTCT scores of the Chinese students to TTCT scores of the NSE students. This data suggests that Chinese students are likely less creative than NSE students as evaluated by the TTCT. In the last part of the thesis, the author concludes that factors such as education, social and cultural environment are even more important than linguistic reason when making a fair and reliable creativity assessment.

### 5.1 Conclusions

The result of this study suggests that the university students who are native speakers of English (NSE) are more creative than the university students with English as their second language (ESL). English ability is not a barrier of Chinese students when doing



the Torrance Test of Creative Thinking. In particular, the NSE students demonstrate more synthesized and organized elaboration in the process of coming up with creative ideas than ESL students. This result may be the exemplification of different educational and cultural background of these two different group participants.

In order to foster creative ability for ESL students, it would be helpful if educational agencies could examine how the creativity of NSE students has been developed. Furthermore, there appears to be no statistical differences in language changes in the TTCT booklet. Chinese college students majoring in mechanical engineering, industrial design, English, math and aerospace engineering are equally creative in TTCT regardless of whether the test version is English or Chinese. Within each subgroup, there was no correlation between English ability and TTCT score, suggesting that as long as students have average English or above there is the potential for creativity, but not guaranteed.

Although the findings of this study indicated statistically significant differences between ESL and NSE college students on the scores of TTCT, ALT and RAT, the result may be limited by the translation process from English to Chinese, cognitive difference of the creativity researchers and the self-rating English ability. Even though these translations were done carefully, no single reliability was obtained. Including the back translation from English to Chinese may help as a validity check. In this study, translation on the question words was carefully conducted, but still there is a need for further considerations in the translation process.

The cognitive differences between researchers to humor and originality for example, may also cause the grading difference. A researcher who comes from American may think one idea is particularly unique and funny, but the researcher from a different country may recognize it as not funny at all or even vice versa. Further, the self-rating English ability could be subjective and detailed sub-criteria of each English level need to be recorded in the future. Other variables not included in the study such as test anxiety may have affected the correlation between students' scores on the TTCT and their English ability. So, better suggestions for grading in the future may need to set specific or detailed information on these rubrics.

Overall, the findings suggest that NSE students are more creative than ESL students in the university class as measured by the TTCT, ALT and RAT. The English ability of ESL are highly correlated with ALT and RAT, but not correlated with TTCT score. Performance on TTCT in English version and Chinese version are of no significant difference with Chinese students and nor does it correlate with their self-rating English ability. Future research is needed to fully understand the contributing factors that causing the observed differences and lack of differences.

## 5.2 Future Work

Since foreign language ability does not have an obvious or strong correlation with TTCT score, it is unnecessary to pay too much attention to foreign language learning when aiming at cultivating students' creative ability, and creative thinking in particular. Educational initiatives such as play, arts, direct instruction, and teacher training etc. have obviously positive functions in creativity development. Education should be sensitive to the linguistic and cultural backgrounds of students and be flexible to enable all students to develop their creativity potential. Training in creativity should be incorporated in high schools, higher education, science, technology, engineering, art, and business organizations. Oades-Sese and Esquivel (2011) pointed out that Creative Problem Solving or Osborn–Parnes Model which uses divergent thinking to brainstorm a number of possible solutions to a problem has been proved to be effective training programs. Other related methods include brainstorming, the art of inquiry (method of questioning that allows the integration of disparate ideas) and creative synthesis (combining unrelated elements or subject matter into a cohesive whole). Computer-based systems in industrial design tasks or product making processes are also useful innovative methods.

Although the score of TTCT shows no direct link between one's creative ability and foreign language ability, language ability is highly correlated with ALT and RAT, which has been clearly indicated by experiments. Thus we can conclude that foreign language learning or being bilingual should never be neglected on the part of students. In order to be a competent and qualified designer, one should be open-minded and able to catch up with the latest development in the field. In this aspect, foreign language is the very tool to help individuals enrich and strengthen their potentials.

Also, the TOEFL score could be incorporate into the study to exam all the students' self-rating English level accuracy. It is worth considering the TOEFL score factor with their subjective rating in order to see if they over estimate themselves or lower estimated. Using the Standard English test result such as TOEFL for evaluation could be more express to conduct the correlation analysis in future study.

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## 7. Appendix

### Appendix A: Remote Associate Test

Questions RAT Test with correct answers adapted from Bowden and Beeman, 2003

- |                         |        |
|-------------------------|--------|
| 1. night wrist stop     | watch  |
| 2. piece mind dating    | game   |
| 3. peach arm tar        | pit    |
| 4. flower friend scout  | girl   |
| 5. dew comb bee         | honey  |
| 6. food forward break   | fast   |
| 7. basket eight snow    | ball   |
| 8. break bean cake      | coffee |
| 9. worm shelf end       | book   |
| 10. shine beam struck   | moon   |
| 11. duck fold dollar    | bill   |
| 12. pie luck belly      | pot    |
| 13. down question check | mark   |
| 14. roll bean fish      | jelly  |
| 15. grass king meat     | crab   |
| 16. fountain baking pop | soda   |
| 17. rocking wheel high  | chair  |
| 18. catcher food hot    | dog    |
| 19. print berry bird    | blue   |
| 20. wise work tower     | clock  |
| 21. test runner map     | road   |
| 22. health taker less   | care   |
| 23. man glue star       | super  |
| 24. dive light rocket   | sky    |
| 25. right cat carbon    | copy   |
| 26. dress dial flower   | sun    |
| 27. force line mail     | air    |
| 28. rain test stomach   | acid   |
| 29. fence card master   | post   |
| 30. cry front ship      | battle |

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## Appendix B: Scoring Worksheet of Abbreviated Torrance Test for Adult

### Abbreviated Torrance Test for Adults (ATTA) Scoring/Interpretation Worksheet

Name \_\_\_\_\_ Age (yrs.) \_\_\_\_\_ Group \_\_\_\_\_ Date \_\_\_\_\_

#### Norm-Referenced Measures

Creative Ability	Raw Scores				Scaled Scores										Scaled Scores
	Activity			Total Score	11	12	13	14	15	16	17	18	19		
	1	2	3		Corresponding Raw Scores										
Fluency					1-6	7	8-9	10	11-12	13-14	15-16	17	18+		
Originality					1	2	3	4	5	6	7-8	9-10	11+		
Elaboration	X				1-3	4-5	6-8	9-11	12-14	15-18	19-23	24-27	28+		
Flexibility	X	X			-	1	-	2	3	-	4	5	6+		
Creative Roles:					Collaborator			Contributor			Accelerator				
Total Scaled Score															

#### Criterion-Referenced Creativity Indicators

##### Verbal Responses (Activity #1)

Tally	Rating	Raw Score	
___	___	___	1. Richness and Colorfulness of Imagery
___	___	___	2. Emotions/Feelings
___	___	___	3. Future Orientation
___	___	___	4. Humor: Conceptual Incongruity
___	___	___	5. Provocative Questions
<b>Total</b>			___

##### Figural Responses (Activities #2 and #3)

Tally	Rating	Raw Score	
___	___	___	6. Openness: Resistance to Premature Closure
___	___	___	7. Unusual Visualization, Different Perspective
___	___	___	8. Movement and/or Sound
___	___	___	9. Richness and/or Colorfulness of Imagery
___	___	___	10. Abstractness of Titles
___	___	___	11. Articulatness in Telling Story
___	___	___	12. Combination/Synthesis of Two or More Figures
___	___	___	13. Internal Visual Perspective
___	___	___	14. Expressions of Feelings and Emotions
___	___	___	15. Fantasy
<b>Total</b>			___

#### Composite Measures

\_\_\_ Total Scaled Score  
 + \_\_\_ Total Indicator Score (Count 1-point for each "+" and 2 for each "++")  
 = \_\_\_ CREATIVITY INDEX (CI)

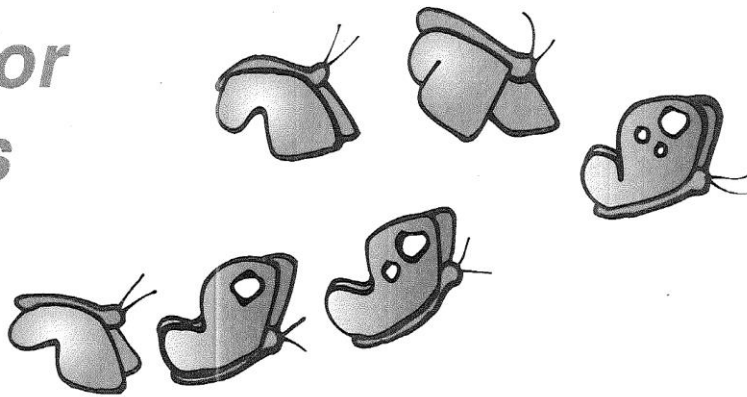
Creativity Index*	1-50	51-59	60-67	68-73	74-77	78-84	85+
Creativity Level	1	2	3	4	5	6	7
Verbal Assessment	Minimal	Low	Below Average	Average	Above Average	High	Substantial
% of Adults in Level	4%	12%	20%	26%	20%	12%	4%

\*Interpretive Aid—Find Creativity Index in top row score range. Use information in that column to help understand the CI.

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**Appendix C: English Version of ATTA**

**Abbreviated  
Torrance  
Test for  
Adults**



by  
**Kathy Goff, Ed.D. and E. Paul Torrance, Ph.D.**

Name: _____	Date: _____	
Sex: _____	Year of Birth: _____	Group: _____

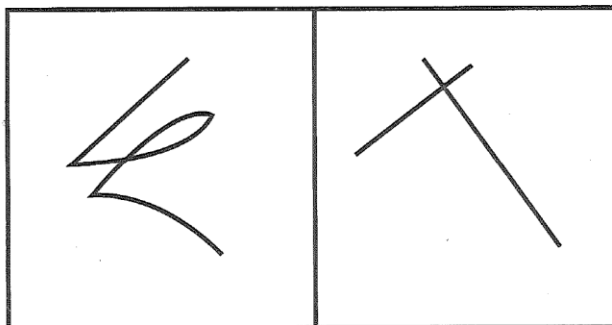


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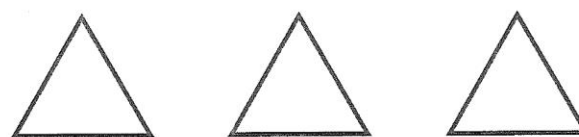
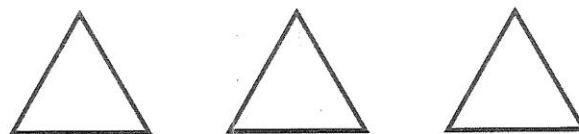
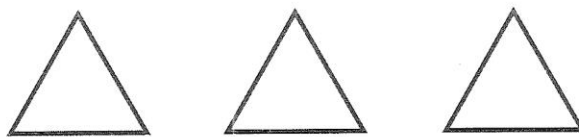
**Activity 2**

Use the incomplete figures below to make some pictures. Try to make your pictures unusual. Your pictures should communicate as interesting and as complete a story as possible. Be sure to give each picture a title.



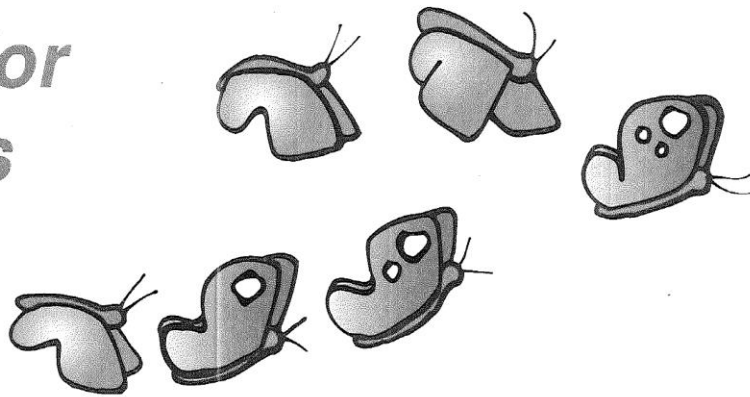
**Activity 3**

See how many objects or pictures you can make from the triangles below, just as you did with the incomplete figures. Remember to create titles for your pictures.



**Appendix D: Chinese Version of ATTA**

***Abbreviated  
Torrance  
Test for  
Adults***



by  
***Kathy Goff, Ed.D. and E. Paul Torrance, Ph.D.***

Name: _____	Date: _____	
Sex: _____	Year of Birth: _____	Group: _____



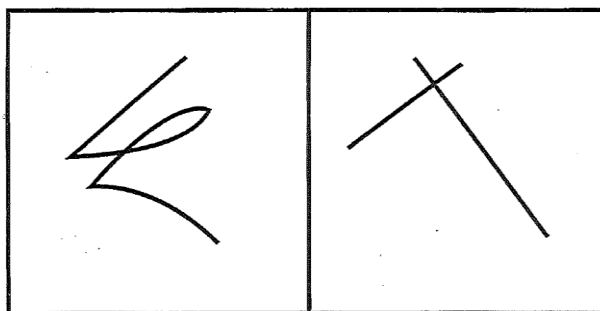
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BENSENVILLE, ILLINOIS 60106-1617



**Activity 2**

请用下面不完整的图案画出完整的图画。试着让自己的图案表现独特性。

你的图案应尽可能的传达出有趣性和故事完整性。最后请给你的图案命名。





**Activity 3**

请用下图的三角形做出图案并给每个做出的图案命名。



## Appendix E: Anonymous Self-Rating and TOEFL Score for Partial ESL students

Self-Rating	TOEFL Score
8	DHA grad student
10	graduated from a US high school
7	87
7	graduated from a US high school
7	87
7	DHA grad student
10	graduated from a US high school
7	90
10	graduated from a US high school
7	82
10	graduated from a US high school
10	Transfer student. Attended two years at a community college in the US.
7	Graduate student in another college
8	Graduate student in another college
10	graduated from a US high school
6	Took two ESL courses spring 2013 with "A" grades. No TOEFL.
10	96
8	82
9	Graduate student in another college

8 Exchange student at the U for one year  
only

7 76

10 Graduate student in another college

9 Transferred from another US college. No TOEFL  
scores

9 No TOEFL. Record of significant English language training in HS with excellent  
grades.

10 Graduated from a US high  
school

5 Was a visiting student for one term  
only

8 100. Attended an American University in another  
country.

7 60, but took several ESL courses the first term  
here.

8 Graduate student in another college

10 Graduate student in another college

6 DHA grad  
student

6 Graduate student in another college

8 Graduate student in another college