The Pennsylvania State University

The Graduate School

College of Education

TIME OF DAY AND CREATIVITY: A COMPARATIVE STUDY OF ARTS AND MANAGEMENT COLLEGE STUDENTS

A Thesis in

Instructional Systems

by

Sy-Chyi Wang

Submitted in Partial Fulfillment
of the Requirements
for the Degree of

Doctor of Education

December 2005

The thesis of Sy-Chyi Wang was reviewed and approved* by the following:

Kyle L. Peck
Professor of Education
Thesis Adviser
Chair of Committee

Catherine Augustine
Affiliate Assistant Professor of Education

Wendy R. Snetsinger
Adjunct Assistant Professor of Education

Keith E. Nelson
Professor of Psychology

Susan M. Land
Associate Professor of Instructional Systems
In Charge of Graduate Programs in Instructional Systems

*Signatures are on file in the Graduate School.

ABSTRACT

The main purpose of this study is to obtain a better understanding of individual difference in the relationship between creativity and its timing. We argue here that timing is an important factor to consider when developing a supportive educational environment for creativity and its performance, particularly among people from different fields.

Two hundred and ninety-seven college students, 154 from the art program and 143 from the management field, participated in this study. A self-reported questionnaire and two idea generation tasks adapted from the TTCT verbal tests were used to collect data on how they think themselves in terms of the most and the least creative moments during a day, and their creativity performance across school time intervals.

The results show significant differences among art and management college students, perceptions of the most creative time intervals during the day, but no differences in terms of the least creative time intervals during the day.

The results also show that the distributions of creativity performance across school time intervals, as measured by the two TTCT activities, present statistically significant differences between groups for fluency and originality; nevertheless, no difference is found on the flexibility and elaboration measures. Further, for the arts

program, statistically significant differences were found in the fluency, originality, and elaboration measures (except for flexibility) with regard to the effects of school time intervals on creativity performance; for the management program, no difference was found for any of the creativity measures. That is, time of day is a concern for creativity performance but not a significant factor for management students when conducting creativity activities.

Based upon the findings that timing is an important factor in creativity, and people in different disciplines may demonstrate different timing patterns in terms of creativity and its performance, this study suggests a free learning environment for creativity, in which individual differences are noticed and respected. It is expected that educational administrators and instructors will give closer attention to the fact that time of day does have influence on creativity, and its performance in terms of fluency and originality, particularly for arts people.

TABLE OF CONTENTS

LIST OF TABLES viii

LIST OF FIGURES ix

ACKNOWLEDGMENTS x

Chapter 1 Introduction 1

Background and Motivation 1

Creativity Education 2

Daily Timing Rhythms 6

Statement of the Research Problem 7

Purpose of the Study 8

Research Questions and Hypotheses 10

Definitions and Terms 13

Delimitations of This Study 15

Chapter 2 Literature Review 17

Creativity 17

Definition of Creativity 17

Creative Process and Behavior 19

Assessment of Creativity 22

Creativity Environment Settings in Education 23

Time of Day 25

Daily Biological Rhythms vs. Learning Performance 25

Time of Day as a Factor in Learning Style 28

Time—The Missing Element in School Scheduling 29

Productive Timing of Creativity 30

Chapter 3 Methods 33

Conceptual Framework 33
Research Design 34
Sampling and Participants 35
Materials 37
The Structure of the Self-reported Questionnaire 37
The Idea Generation Tasks 38
Procedures 41
Definition of Variables 45
Analytical Approach 50
Descriptive Analysis 50
Inferential Analysis 51
Chi-square Tests 51
Two-way Analysis of Variance 52
One-way Analysis of Variance 52

Chapter 4 Results 53

Descriptive Statistics 53
Background Characteristics of the Study Samples 54
Performance Score on Idea Generation Tasks 56
Empirical Results 57
Distribution of Self-perceived Most and Least Creative Times 57
Idea Generation Tasks Performance 63
Creativity Performance of Fluency 65
Creativity Performance of Flexibility 66
Creativity Performance of Originality 68
Creativity Performance of Elaboration 69
Idea Generation Tasks Performance in the Arts Discipline 71
Idea Generation Tasks Performance in the Management Discipline 74
Summary of Empirical Results 75

Chapter 5 Discussion and Conclusion 80

Interpretation of Empirical Results 80
Distributions of Self-perceived Most Creative and Least Creative Time Intervals 81
Self-perceived Most Creative Time Intervals 81
Self-perceived Least Creative Time Intervals 83
Interaction Effects of Discipline and Time of Day on Creativity Performance 84
Time of Day and Performance in the Arts Program 84
Time of Day and Performance in the Management Program 86
Arts People vs. Management People 86
Differences among the Measures of Creativity 87
Implications of the Study Findings 89
Pedagogical Implications 90
"Bad Student," "Lousy Teacher," or "Wrong Time" 90
A State or a Trait 91
School Scheduling Change or Student Routine Behavior Change 92
Research Implications 93
Industry and Societies 94
Limitations of This Study 96
Generalizability Issue 96
Measurement Issue 97
Suggestions for Future Studies 99
Conclusion 100

References 102

Appendix A: Self-reported Questionnaire 114

Appendix B: Creative Idea Generation Tasks (English Version) 115

LIST OF TABLES

Table 3.1. Operational Definitions and Measures of Variables 45
Table 4.1. Statistical Description of Characteristics for the Study Sample 55
Table 4.2. Distributions of Self-perceived Most Creative Times 58
Table 4.3. Distributions of Self-perceived Least Creative Times.....61
Table 4.4. Results of Interaction Effect on Idea Generation Task Performance for Fluency.....65
Table 4.5. Results of Interaction Effect on Idea Generation Tasks Performance for Flexibility 67
Table 4.6. Results of Interaction Effect on Idea Generation Tasks Performance for Originality 68
Table 4.7. Results of Interaction Effect on Idea Generation Tasks Performance for Elaboration 70
Table 4.8. Results of Creativity Performance across Time Intervals for the Arts Program.....73
Table 4.9. Results of Creativity Performance across Time Intervals for the HCA Program 75
Table 4.10. Summary of Major Findings and Testing Results for Hypotheses 78

LIST OF FIGURES

Figure 3.1. A conceptual framework of the research design 34

Figure 3.2. Assignment of participants into time intervals.....37

Figure 3.3. A flowchart of the research process 43

Figure 4.1. Diagram for the distributions of self-perceived most creative times 59

Figure 4.2. Diagram for the distributions of self-perceived least creative times.....62

Figure 4.3. Means of fluency performance in idea generation tasks in each discipline 66

Figure 4.4. Means of flexibility performance in idea generation tasks in each discipline 68

Figure 4.5. Means of originality performance in idea generation tasks in each discipline.....69

Figure 4.6. Means of elaboration performance in idea generation tasks in each discipline 71

Figure 4.7. Diagrammatical illustration of two-way ANOVA analysis 76

Figure 4.8. Diagrammatical illustration of one-way ANOVA analysis 77

ACKNOWLEDGMENTS

For all of the conversations and discussions held, one after another, the papers, emails, and e-files passed back and forth, and the ideas incubated from vague to firm, words need to be spread here to express my most appreciation to all those who helped plow the field of creativity in a critical way.

The completion of this study has been guided and supported by my dissertation committee:

Dr. Kyle Peck, chair of committee, for his granting me high "degrees of freedom," which allowed me to experience the unexpected but inevitable ups and downs on the way and to prepare myself for research in the future; and for his tolerance of and respect for individual difference, which allowed me to delightfully mark myself with the word "different," rather than drying up under "has-to-be" conditions.

Dr. Keith Nelson, Department of Educational Psychology, for his support and mentoring, particularly when the ideas in my early work were still viewed as heretical and limited; and for his generous giving of his time to "work together," as well as his thoughts about expanding possibilities.

Dr. Catherine Augustine, for her kindness, caring, and concern for me as well as my work, in helping me to take one more step toward my dreamland; and for her research expertise and special interest in the domain of creativity exploration which allowed me to walk me through the wonderland.

Dr. Wendy Snetsinger, for her instruction and encouragement on this journey through the INSYS program which helped me set sail for the adventure onto the vast ocean of research; and for her considerateness and kindness in making this study more joyful.

I would also like to thank all of the faculty members in the INSYS department, particularly **Dr. Dywer, Dr. Carr-Challman, Dr. Shama, Dr. Smith, and Dr. Land,**

for fostering (sometimes beyond the call of duty) my critical and creative thinking abilities and equipping me with domain knowledge for the challenges ahead of me. In addition, a special thank you goes to **Miss Carpenter Lee**, the editor of my dissertation; if you found reading this dissertation joyful and smooth, that is because she spent a lot of effort editing and polishing up the draft.

Although just a snapshot in my life, living in State College will remain memorable forever in my heart. Among the rest, I wish to convey my most sincere gratitude to the friends who enriched my doctoral life in "Happy Valley"—**Chung-Pei Chuang and Wei-Fan Chen**, whose kindness and concern helped me work through difficulties and problems; **Shao-Wei Wu and Meng-Fen Hsieh**, two resourceful information agents who always provided timely help and advice for all my trivial questions and endless requests; and **Ellen (Ya-Lun Tsao) and Jessica (Chih-Lin Chiang)**, two unbelievably easy-going girls who made my student life here more delightful.

A last but most important thank you is given to my family: **to my parents** who disciplined me to look at reality and taught me about caution, but gave me the wings to fly freely when the time came to enthusiastically pursue my "dream" (a word they don't usually dare to use); **to my brother and sister**, who didn't quite understand my trade-offs for this doctoral degree, but still provided me with whatever they could to help me through; **to my two mischievous but super** adorable daughters, **Yuni and Jessika**, whose giggling and naivete helped turn the monotonous writing and computer tones into joyful and exciting life rhythms, and whose crying and fussiness helped push me to run through the academic jungle faster and more determinately; and finally, **to my husband**, who always stood a step behind me, scrutinizing, questioning, and criticizing each little mistake I came to or might come to, which in turn really helped to mold me into an academic "doctor."

Chapter 1

Introduction

Background and Motivation

> Sheldrade (1994) proposed that each kind of thing has a "morphic field" which gives its form, pattern, field, or structure. Under standard conditions anywhere in the world, permutations in one morphic field will occur more readily over time in similar organisms through inheritance of habits. The hypothesis enables the regularities of nature to be understood as regulated by inherited habits and not by universal and eternal underlying principles (Sheldrade, 1994). Similar to the concept proposed by Jung (1961), " …the collective unconscious to be seen not just as a human phenomenon but as an aspect of a far more general process by which habits are inherited through nature" (Sheldrade, 1994, p. 117).—adapted from Jane Piirto (1999a)

Quite often we heard people, particularly people in the arts, say something like "right now is not my time," "I am a dead person at this moment," or "I only live after mid-night." Maybe these comments sound a bit dramatic or irresponsible to some people and spontaneously lead them to conclude that people from arts fields

are usually, more or less, moody. However, keeping in mind the image patterns of "night owls," "moodiness," or "ups and downs" for persons in the arts, the writer cannot help but ask: Are people in the arts, as highly creative individuals, really different from people in other fields in terms of their learning performance? Does creativity have certain timing patterns that make artists appear to be a bit "odd" and "irregular"? In short, are creativity timing patterns the same or different from person to person, and from group to group?

Along this line of inquiry, the background of this study may be depicted from two dimensions: creativity education and daily timing rhythms.

Creativity Education

The arts in the 1970s began to use the term "Postmodern," which refers to poststructuralist philosophy, the reconceptualization of curricula that emphasize freedom and aesthetics, and calls for attention to the human spirit, not technique. The orientations toward teaching for insight, designing an educational environment that values educational activity, and fostering creativity, led educational reform since the 1970s to place equal value on the arts and humanities and on the sciences and mathematics (Piirto, 1999b).

Since then, creativity has been receiving a great deal of attention from researchers (Souza Fleith, 2000). Many educators, researchers, and theorists argue

that the importance of creativity in school learning cannot be overemphasized. In fact, it has been well recognized and accepted that creativity is an important ingredient in education and instruction.

Further, many models and theories have been established and claimed in an attempt to provide better understanding of creative thought and the development of creativity (e.g., Finke, Ward, & Smith, 1992; Isaksen & Parres, 1985; Merrifield, Guilford, Christensen, & Frick, 1962; Wallas, 1926). Other researchers consider creative thought to be an unconscious, uncontrollable phenomenon and stress the importance of the "aha" experience, where an idea "jumps" out of the mind suddenly after a few "working" stages such as preparation and incubation (e.g., Arieti, 1976; Dallob & Dominowski, 1992; Wallas, 1926). Nevertheless, some people believe it is a conscious process and can be controlled (Munford, 1998). Others insist that creativity is one kind of ability that happens rarely, whereas other individuals view it as a general ability possessed by normal people to some degree. Some suggest different levels of creativity to differentiate among big-picture creativity (the big "C") and everyday creativity (the little "c") (e.g., Csikszentmihalyi, 1995; Maslow, 1968).

Among those who argue that creativity is a method or a magic, an innate structure or an ability, or a cognitive process or a product, most researchers believe that "creativity is the natural propensity of human being-ness" (Piirto, 1998, p. 41),

and it can be “either enhanced or stifled” (Ibid). Furthermore, Osborn (1963) and Parnes (1967) argue that creativity may be increased through practice. Thus, innumerable books, papers, conferences, and seminars have devoted significant time to relevant issues such as the definition of creativity, the cognitive process of creativity, and the assessment of creativity in an attempt to explore how to “cultivate” an individual’s creativity.

In the past four decades, after more than 9,000 published works (Beattie, 2000), creativity research findings show that creativity may be developed through the appropriate design of the learning environment, causing a deep impact on contemporary teaching strategies and educational settings (Souza Fleith, 2000). In other words, it has become essential for instructors and relevant authorities to create a supportive educational environment for learning, if the development of learners’ creativity is the major issue of concern.

With regard to the creation of supportive educational environments, hundreds of experiments have focused on the exploration of teaching methods or instructional procedures to help learners become more creative in dealing with problems. Among the rest, several reports and articles (e.g., Astin, 1993; Cole, Sugioka, & Yamagata-Lynch, 1999; Morganett, 1991) have investigated teachers’ role in building teacher-student relationships to help create a supportive environment.

Other research suggests that an “outside-the-classroom” approach would be

helpful for the block-of-time scheduling solution (Hackman & Schmitt, 1997). Some present evidence that time press (specified time limits) has a tendency to obstruct divergent production (Borland, 1988; Johns & Morse, 1997); and some work on using class size as a factor in the evaluation of creativity. Nevertheless, few studies place emphasis on the investigation of creating a supportive environment from the time perspective, specifically the most productive moment of creativity.

One of the few studies related to the investigation of the most productive occurrence timing for creativity was conducted by Sternberg and Lubart (1991), which, however, was about occurrence timing in a lifetime fashion. No study has exclusively focused on the exploration of occurrence timing for the most productive moment of creativity on a daily basis.

Oldach (1995) details in his book the meanings and functions of different stages in the creative process and stresses the importance of stepping back from the jumble of thoughts to be aware of one's own most productive timing for creativity during the creative process. Krathwohl (1997) argues that, "Clearly…some pattern is better for each of us, and we must find it" (p. 94) and encourages people to find their own most productive conditions with regard to when and where to work. In other words, understanding one's own most productive timing for creativity is an important consideration in scheduling creativity-related work.

Daily Timing Rhythms

Research has confirmed that the human body has its own internal timing and that many body rhythms vary significantly from the average pattern (Callan, 1997). These rhythms are called circadian rhythms. More than 100 circadian rhythms have been identified, such as blood pressure, respiration rate, and body temperature, which recur daily (Mayo Clinic, 1995). These around-the-clock circadian cycles of change affect learning performance. Performance and achievement on various tasks have been confirmed to follow these rhythms (e.g., Biggers, 1980; Davis, 1987). Therefore, the issue of the relationship between time-of-day and effectiveness of learning has been studied and explored in many domains and directions. In the last decades, a large number of studies were carried out to contribute to the optimal arrangement of school timetables. More researchers started to emphasize the importance of school scheduling. They realized that by uniformly scheduling the school day without considering individuals' or groups' differences, students may never be able to achieve their maximum performance.

Time of day has been identified as one of only five of the 21 Dunn and Dunn learning-style elements that fully affect the achievement of 70% of students (Dunn & Dunn, 1992, 1993; Dunn, Dunn, & Perrin 1994). Many learning styles programs have been developed at schools, and many research reports have shared practical experiences on how learning style boosts achievement and makes a difference (e.g.,

Klavas, 1994; Lemmon, 1985). Furthermore, as one of the factors in learning style, time of day has revealed that students may learn and test better at their “best” time (Dunn, et al., 1987; Klavas, 1994; Lemmon, 1985).

Statement of the Research Problem

As mentioned earlier, during creative processes, creators prepare, incubate, and then wait for the “aha experience,” the inspiration stage, for ideas to jump out from their chaotic thoughts. “Right on my time or not” seems to have always been a critical issue for creators with regard to incubation and inspiration activities. However, although creativity education has become more widespread over the last several years, and environmental factors and their influence on development have long been studied, most studies of the creation of a supportive environment for creativity have focused on physical space and emotional encouragement. As a matter of fact, no studies have examined whether daily timing rhythm is a factor in creativity, especially in school, educational settings.

Similarly, research has confirmed that the human body has its own internal timing and body rhythms vary significantly from person to person (Callan, 1997). Performance and achievement on various tasks has been confirmed to follow these rhythms (e.g., Biggers, 1980; Davis, 1987). However, despite the acknowledgement and exploration of the relationship between time of day and learning performance by

a number of researchers, the existing literature reveals no research on the phenomenon in creativity learning performance.

Everyone who has lectured to sleepy students knows how hard it is to teach the "night owl" learning-style student under the present school scheduling system. The learners' individual differences and needs are one of the most important factors to consider when deriving the arrangement of school timetables (Schroth, 1997). However, in the real world, this type of arrangement is often overlooked due to the difficulty of investigating and integrating individual differences, particularly the timing issues (Tang, 1987).

The lack of studies on the daily timing pattern in creativity and its differences among individuals was the impetus for this study. Here, a subjective survey and objective idea generation tasks in two different disciplines (creativity-highly-related and creativity-not-highly-related) were used to investigate cross-disciplinary differences among individuals' daily timing patterns for creativity, and the effects of time of school day on creativity performance.

Purpose of the Study

In light of these research problems, the purpose of this study is to obtain a better understanding of individual difference in the relationship between creativity and its timing. The central argument is that timing is an important factor to consider

when developing a supportive educational environment for creativity, and particularly for people from different creativity-highly-related and creativity-not-highly-related fields. Do the best and worst time intervals for creativity during the daytime period vary among individuals across different disciplines? Will the timing of the performance of creativity in school vary among individuals from different disciplines?

To be more specific, the main purposes of this study are to examine, from the perspective of occurrence timing during the day, (1) the cross-disciplinary (e.g., creativity-highly-related vs. creativity-not-highly-related) differences in the relations between daily time intervals and creativity—whether or not there is a significant difference in the timing pattern for the most and the least creative moments among students from different disciplines; and (2) the cross-disciplinary differences in the relationship between time intervals in school, not around the clock, and creativity performance in idea-generation tasks—whether or not there is a significant cross-disciplinary difference in the effect of time of day on creativity performance in idea generation tasks.

The results of this study are expected to provide a better understanding of individual differences in creativity timing patterns, and serve as potential answers to questions such as “How can you be so creative in the early morning while I just cannot think of a thing at this time?” Specifically, with the intent of having better

practice implications related directly to curriculum and instruction, this study investigated whether timing is a significant factor in creativity performance in the educational environment. The results of this study are also expected to contribute to the optimal arrangement of school timetables focused on the development of creativity.

Research Questions and Hypotheses

Following from the aforementioned problems, two research questions deserve thorough examinations:

1. Is there any difference between arts and management college students in terms of timing patterns for the most and the least creative time intervals during the day?
2. Is there any difference between arts and management college students in the effects of time of school day on creativity performance (fluency, flexibility, originality, and elaboration, respectively) in idea generational tasks? Furthermore, is there a difference in creativity performance among school time intervals in each discipline?

In light of these research questions, the hypotheses may be postulated as follows.

Hypothesis 1-1: There is no statistically significant difference between Arts and Management college students in terms of timing patterns for the most creative time intervals during the day

Hypothesis 1-2: There is no statistically significant difference between Arts and Management college students in terms of timing patterns for the least creative time intervals during the day.

Hypothesis 2-1a: There is no statistically significant difference between Arts and Management college students in the effect of time of school day on creativity performance for fluency in idea generation tasks.

Hypothesis 2-1b: There is no statistically significant difference between arts and management college students in the effect of time of school day on creativity performance for flexibility in idea generation tasks.

Hypothesis 2-1c: There is no statistically significant difference between arts and management college students in the effect of time of school day on creativity performance for originality in idea generation tasks.

Hypothesis 2-1d: There is no statistically significant difference between arts and management college students in the effect of time of

school day on creativity performance for elaboration of idea generation tasks.

Hypothesis 2-2a: There is no statistically significant difference in the idea generation task performance of fluency across school time intervals for arts majors.

Hypothesis 2-2b: There is no statistically significant difference in the idea generation task performance of flexibility across school time intervals for arts majors.

Hypothesis 2-2c: There is no statistically significant difference in the idea generation task performance of originality across school time intervals for arts majors.

Hypothesis 2-2d: There is no statistically significant difference in the idea generation task performance of elaboration across school time intervals for arts majors.

Hypothesis 2-3a: There is no statistically significant difference in the idea generation task performance of fluency across school time intervals for management majors.

Hypothesis 2-3b: There is no statistically significant difference in the idea generation task performance of flexibility across school time intervals for management majors.

Hypothesis 2-3c: There is no statistically significant difference in the idea generation task performance of originality across school time intervals for management majors.

Hypothesis 2-3d: There is no statistically significant difference in the idea generation task performance of elaboration across school time intervals for management majors.

Definitions and Terms

The concepts of creativity performance and its timing are too broad to be addressed in a single volume. Therefore, this section provides the boundaries and working definitions only for the key concepts used and defined in this study. The overall operational definitions and measurements of the variables are stated and listed in Table 3.1 (see chapter 3).

Creativity Performance This study investigates how students perform creative idea generation activities in the educational environment. The scope of this study does not tap all of the abilities involved in creative behavior. Consequently, it will be useful to clarify what is meant by creativity performance—the result of the assessment of a creative generation activity performed in educational settings, that is, the evaluation of generated creative ideas, judged by others, in terms of fluency, flexibility, originality, and elaboration.

Fluency—the quantity of responses to stimuli; the ability “to produce a large number of ideas” (Torrance, 1974, p. 57)

Flexibility—the quantity of categories of responses to stimuli; the ability “to produce a variety of kinds of ideas, to shift from one approach to another” (Torrance, 1974, p. 57)

Originality—the uniqueness of the responses which are statistically infrequent; the ability “to produce ideas that are away from the obvious, commonplace, banal, or established” (Torrance, 1974, p. 57)

Elaboration—the imagination and exposition of detail to the stimuli, which seems to represent the characteristics of a person—“inventive and take constructive action” (Torrance, 1974, p. 58)

Creativity Timing It is the best time period for the behavior-producing products that are useful as well as original (Amabile, 1983). This taps all kinds of abilities involved in the behavior.

Creativity Performance Timing It is the productive time of creativity, that is, the best time period for being both creative and productive.

Funk and Wagnalls (1977) state that the concepts of “creativity” and “productivity” need to be distinguished. Being productive does not necessarily mean being creative at the same time. In this study, it is defined as the productive timing of creativity, which means the time period for being both creative and productive for

the better performance of creativity.

Time Intervals Four 2-hour class intervals during a school day, 8:10 am to 10:00 am, 10:10 am to 12:00 pm, 13:20 pm to 15:10 pm, and 15:20 pm to 17:10 pm.

Delimitations of This Study

This study focuses primarily on investigating the daytime intervals for the better performance of creativity in the educational environment. In other words, it is not about a thorough investigation of an individual's or a group's creative ability and/or its relevant measurement issue, nor is it about a discussion of the entire creative process. Moreover, this study focuses specifically on examining others' perceptions (i.e., actual performance) of creativity and its timing, although the information on participants' self-perceptions was also collected for comparison. Therefore, three things need to be kept in mind throughout this study to avoid possible distractions.

1. In order to distinguish relative performances of creativity at different daytime intervals, certain techniques for the measurement of creativity performance are needed. However, the assessment of creativity is not the issue of interest in this study. In other words, this study is not about assessing the student's performance or looking for the student's creative

ability. Therefore, the strengths and weaknesses of different assessment techniques are not discussed in detail.

2. As described earlier, many models of creative thought have been proposed to obtain a better understanding of creativity. The general portraits of creative thought are often fashioned from several stages and steps. However, this study does not analyze each stage (i.e., preparation, incubation, etc.) of creative thought for the investigation of creativity occurrence timing. Instead, it only focuses on the most productive (for both quality and quantity) moment of creativity, an inspiration, a solution to the problem, or an “aha” experience in which an idea “jumps” out of the mind in a short period of time.
3. In order to get an overall understanding of the relations between creativity performance and its timing, this study also collected data on participants’ self-perceptions of timing patterns for their most and least creative moments. However, the main theme is the actual performance of creativity as evaluated according to others’ perception. Therefore, the possible discrepancy and relations between self-perception and others’ perceptions of creativity and its timing are not discussed in this study.

Chapter 2

Literature Review

For a better understanding of this study, some background knowledge is needed of the research problems investigated, and certain terminologies and concepts need to be clarified. Hence, this chapter begins with an overview of creativity research, including definitions of creativity, descriptions of creative processes and behaviors, and environmental settings for creativity learning and creativity measurement. Second, biological rhythms and learning performance, learning style, and school scheduling are partially introduced and discussed. Relevant studies related to the productive timing of creativity performance are described.

Creativity

Definition of Creativity

What is creativity? What does it mean to be creative? Is creativity an ability, an aptitude, or a trait? According to dictionaries, generally speaking, creativity means "to bring into existence." However, in the vast body of creativity literature, educators and psychologists have various conceptions of the definition of creativity. When we attempt to define creative thinking, we have to accept the fact that it is "unlikely that consensus will occur for any given definition" (Fishkin, 1999, p.5).

Truly, in recent research, there is still continuing confusion about its definition as well as a debate about the ability to think creatively. Some people view it as a gift from God, an unconscious phenomenon of nature without control; some people think it is a controlled process and stress the importance of knowledge and the ability of conscious analogical reasoning on creativity (Munford, 1998). Some people think creativity is a decision (Sternberg, 2000); some people see it as a mental process (e.g., Gallagher, 1975; Parnes, 1967; Wallas, 1926; Wiles & Bond, 1981). Some believe that creativity is about discovery, the ability to see things as they are, which is mostly fostered by pure observation (Gow, 2000); some define creativity as the cognitive ability to produce novel ideas (Saeki, Fan, & Dusen, 2001). Some suggest different levels of creativity to differentiate among big-picture creativity (the big "C") and everyday creativity (the little "c") (e.g., Csikszentmihalyi, 1995; Maslow, 1968).

Paul Torrance, a pioneer in creativity research for almost four decades (Treffinger, 1997), expresses his feeling on this enduring difficult question during an interview with Shaughnessy (1998), "I have struggled with this question for 40 years" (p. 441). He describes his scientific definition of creative thinking as "the process of sensing difficulties, problems, gaps in information, missing elements, something askew; making guesses and formulating hypotheses about these deficiencies, evaluating and testing these guesses and hypotheses; possibly revising

and retesting them; and finally communicating the results" (p. 442). Rhodes (1961), who focuses his research on the definition of creativity, thinks that creativity involves four components and can be defined in these four different dimensions (so-called 4P)— person (i.e., personality, behavior), process (i.e., cognitive process), product (i.e., innovation), and place (i.e., press, environment), which might well construct the various conceptions about the definition of creativity.

Along with these studies, three themes need to be examined closely: how does creativity proceed (process); how does one measure creativity (assessment); and how does environment (place) influence creativity? Each of these themes is detailed below.

Creative Process and Behavior

Briefly, the creative process indicates the steps or process of creative thought, from the beginning through the end, in relation to certain creative activities, or creative "problem solving." Generally speaking, the process is comprised of three to five steps; among the rest, seeking fact, seeking ideas, and seeking solutions are the three fundamental ones (Osborn, 1963). Added to them are problem finding and acceptance finding (Parnes, 1967). On the other hand, Olson (1977) organizes the four phases as defining the problem, opening to possible solutions, identifying the best solution, and transforming it into action.

Going beyond a mere description of status at each step, Oldach suggests in his book, Creativity for Graphic Designers (1995), that questioning, analyzing, and researching relevant information thoroughly helps to ease the creative process. Resonating with his suggestion, Munford (1998) states that one needs to first gather information and organize it appropriately, and then create new understandings through combination and reorganization in the creative process.

From a more general perspective, Wallas (1926) identifies four stages for creative process: preparation, incubation, inspiration, and verification. Imaginably, preparation, the first stage, is a conscious process in the fundamental development of knowledge (Wiles & Bond, 1981). Verification, to the contrary, is the final stage of evaluating and refining the solution (product) and seeking feedback from others. Put differently, preparation is about gathering information and organizing it properly; verification is about proving, performing, or displaying the idea (solution) and preparing it for use effectively.

The interesting phenomenon about the creative process is that when creators hit the stage of incubation, as Kirschenbaum (1998) describes it, they temporarily shift their attention away from the main problem and seek relaxation, letting the internal thoughts flow toward unconscious problem solving. As a matter of fact, many studies of creative thinkers' "incubation" behaviors even suggest that solitude seemed to be a necessary condition during some aspects of the creative process

(Piirto, 1999c).

In addition to the taste for “solitude,” Piirto also lists 12 other categories of characteristics for creators during their creative process, including “like to walk,” “crave silence,” “seek solitude,” “get inspiration from the muse,” etc. Moreover, during the interview with Shaughnessy (1998), Paul Torrance, who has made great contributions to teaching and research on creativity-related issues, states possible activities during the incubation stage, which include keeping the mind open, being aware of emotions, letting humor flow, and so on. In a word, it seems not to be unusual or even popular to see certain specific behavior patterns for individuals in the incubation stage of the creative process.

After the incubation comes the inspiration stage. Briefly, inspiration is the stage that includes the “aha” experience, where creators feel excited and empowered to work on a solution (Kirschenbaum, 1998). Although creative individuals might still be puzzled about the where and how of ideas, internal thoughts have already led to unconscious problem solving, which is often stimulated by external sources and events (Haensly & Roberts, 1983). From the perspective of teaching and learning, it is then worthwhile to pay more attention to the planning and design of external sources and events.

Assessment of Creativity

Can creativity be measured? Theoretically, the answer is “yes.” Actually, there has been increasing interest in research on the assessment of creativity since Guilford’s “Structure of Intellect Model” (Guilford, 1967; Hickey, 2001), in which it is hypothesized that creativity consists of the divergent thinking factors of fluency, flexibility, originality, and elaboration (Hickey, 2001). Ever since then, many researchers have believed that creativity is a unique potential held by humans and should be distinct from intelligence; thus, it needs a specialized identification (Kwon, Goetz, & Zellner 1998; Torrance, 1962).

To appropriately measure the diverse facets of creativity, Hocevar (1981) identifies ten ways, namely, tests of divergent thinking, attitude and interest inventory, personality inventories, biographical inventories, teacher nominations, peer nominations, supervisor ratings, judgment of products, eminence, self-reported creative activities, and achievement. Although there are still a lot of questions and arguments about the reliability and validity of the assessment of creativity, many researchers look at the positive aspects of creativity measurement and suggest that creativity tests are worth using (Cropley, 2000; Houtz & Krug, 1995).

As demonstrated in the literature, among the various creativity assessment instruments, the Torrance Tests of Creative Thinking (TTCT) (Torrance, 1966, 1974, 1981, 1990, and 1999) are the more famous and frequently used tests (Hickey, 2001;

Houtz & Krug, 1995). Briefly, the TTCT instruments examine both “thinking creativity with pictures” (figural form) and “thinking creativity with words” (verbal form).

Based on Guilford’s measurement factors of divergent thinking, the TTCT verbal form is scored on three characteristics: fluency (the quantity of responses to stimuli), flexibility (the quantity of different categories of responses to stimuli), and originality (the uniqueness of the responses which are statistically infrequent). On the other hand, the TTCT figural form yields scores on five characteristics: fluency, originality, elaboration, abstractness of titles, and resistance to premature closure (Corpley, 2000).

Ever since its initial publication in 1966, the Torrance Tests have been intensively reviewed many times (e.g., Chase, 1985; Crockenberg, 1972; Treffinger, 1985), and have a widespread reputation internationally. Not surprising, due to its popularity, the TTCT has been translated into many languages (Houtz & Krug, 1995).

Creativity Environment Settings in Education

While creative abilities seem to be “personal,” a large body of research on creativity in educational settings argues that a supportive and meaningful environment can be helpful for fostering creative potential (Coleman & Colbert,

2001; Souza Fleith, 2000). However, the literature also reveals that many school students easily lose their creative potential due to the lack of a supportive environment for creativity, and sometimes the suppression of creative expression, in most existing educational settings (Shaughnessy, 1991; Sternberg & Lubart, 1991).

What are creativity supportive environments? Coleman and Colbert (2001) divide the supportive environments for creativity into two considerations: physical and emotional. For the physical settings, as Shallcross states earlier (1981), spaces for group discussion and rooms in which students may work alone are necessary. Objects or wall decorations, which can function to encourage or enhance creative thinking (La Greca, 1980; Mohan, 1971), and spaces to display students' portfolios, can contribute inspiration and self-esteem, and are thus important in educational settings (Coleman & Colbert, 2001).

An open environment where students are encouraged to share their ideas (Coleman & Colbert, 2001) and not "afraid to take risks, afraid to explore new ideas, and afraid to fail" (Cole, Sugioka, & Yamagata-Lynch, 1999; Kawenski, 1991, p. 263) are essential in the creativity classroom. Moreover, several studies have shown that deadlines (time press) may decrease creativity and divergent thinking (Amabile, Dejong, & Lepper, 1976; Borland, 1988; Johns & Morse, 1997; Sajjadi-Bafghi, 1984). To the contrary, a pre-warm-up exercise may be helpful and have a positive effect on the latter portion of creativity (Johns, Morse, & Morse, 2001; Maltzman,

1960).

In summary, both physical and emotional supportive environments are essential to fostering creative potential, as demonstrated in the literature. Beyond the consideration of spatial issues, the concern for timing issues is necessary and is explored below.

Time of Day

Daily Biological Rhythms vs. Learning Performance

Research has confirmed that the human body has its own internal timing and that body rhythms vary significantly from person to person (Callan, 1997). These rhythms are called circadian rhythms. More than 100 circadian rhythms have been identified, such as blood pressure, respiration rate, and body temperature, and recur daily (Mayo Clinic, 1995). From the viewpoint of education, those rhythms deserving closer scrutiny have to do with the clock circadian cycles of changes that may affect learning performance. Put differently, performance and achievement on various tasks have been confirmed to follow these rhythms (e.g., Biggers, 1980; Davis, 1987). Therefore, the relationship between time-of-day and effectiveness of learning has been studied and explored in many domains and directions. For example, in the past few decades, a large number of studies have looked at the optimal arrangement of school timetables. Among them, a generally accepted

concept is that subjects related to short-term memory receive better performance levels in the morning while long-term memory-related subjects are better in the late afternoon (e.g., Hockey, Davis, & Gray, 1972; Millar, Styles, & Wastell, 1980).

A well-known research study conducted in the late 1980s (see Folkard, 1979; Folkard & Monk, 1978), which parallels those on circadian changes in hemispheric dominance, proposes that the left hemisphere of the brain controls the processing of acoustic data (i.e., short-term memory and routine activities), and performs better during the morning hours. On the other hand, the right hemisphere, which is responsible for visual information containing relatively less semantic components and perceptual tasks, functions better during the afternoon hours. Morton and Kershner (1993) conducted a study of 12-year-old children and found that left-hand children performed better in the afternoon and that right-handed children performed better in the morning. This finding was attributed to changes in hemispheric dominance. Similarly, gifted people are found to have higher achievement levels during the afternoon, mainly due to their better ability to process long-term memory in that time frame (Morton & Kershner, 1985). While further investigations are still needed to prove the correlation between changes in hemispheric dominance and performance rhythms (Eysenck, 1982), most research in this area supports the notion of circadian shifts in memory efficiency throughout the day, which in turn reflects changes in the levels of cognitive performance.

In the meantime, some research looked at circadian body temperatures between the so-called morning- and evening-type persons and proposed that evening-type persons had a relatively lower body temperature at the beginning of their work day and reached their peak approximately an hour later than evening-type persons (Horne & Östberg, 1977). The circadian variations in subjective alertness were also found to be significant between the two types of persons, with the morning-type feeling most alert in the late morning and the evening-type more so in the late afternoon (Natale & Cicogna, 1996). Interestingly, most children were found to fit the morning type, while university students were mostly evening type (Ishihara, Honma & Miyake, 1990). In recent research, whether a person is of morning or evening type seems to be an important concern in studies of the effect of time of day on memory performance (Adan, 1991; Natale & Lorenzetti, 1997).

In addition, it has been found that work functioning declines during the early afternoon due to biorhythms (e.g., Blake, 1971; Javierre et al., 1996), although this was first ascribed to after-lunch sluggishness. In fact, Gates (1916), a pioneer researcher in this field, concludes that the forenoon is the best time for strictly mental work. Similarly, Kellogg (1986) reports that regular writing for 1-2 hours before lunch every day is associated with higher productivity and concludes that scientists and writers like to work in the morning most while athletes have their deliberate practice in the afternoon.

Time of Day as a Factor in Learning Style

Many learning style programs have been developed at schools and many research reports have shared their practical experiences on how learning styles boosted students' achievements and made a difference (e.g., Klavas, 1994; Lemmon, 1985). Learning style, as conceptualized by Dunn (1998), is "individuals' positive reactions to certain elements introduced into their environment when they are concentrating on difficult academic information" (p. 24). These elements, such as quiet sound, bright or soft light, and cool or warm temperatures, describe the most positive mode for processing and internalizing academic knowledge (Dunn, 1998).

Among the many factors in learning style, time of day deserves more attention. It has been shown that students will learn and test better at their "best" time (Dunn, et al., 1987; Klavas, 1994; Lemmon, 1985). Also, it is popularly recognized that "morning birds," "later morning referents," "afternoon types," and "night owls" all have their specific time of performance. Generally speaking, the early afternoon right after lunch is the most unwelcome time block for class schedules; Monday is the day when students express the least willingness for class; and science and mathematics are expected to be managed during the morning hours, as indicated in an survey of university students' time preference and willingness for school timetabling (Wang, 2004). Further, in an empirical study, Dunn (1998) even

identifies the time of day as one of the only five elements from the 21 Dunn and Dunn learning-style elements that fully affect the achievement of 70% of students. Following this thread, it seems helpful and necessary to propose effective guidelines for school scheduling based upon students' time preferences.

Some in-depth research has declared that mid-morning (around 11:00 am) is the period of peak efficiency for most students' performance (Dunn, 1993). Interestingly, it seems to be consonant with Gate's theory in the area of biorhythms, in which forenoon was declared to be the best time for "mental work." It also parallels Kellogg's (1986) report on writing, scheduling, and productivity between science and engineering faculty, where the time period of 1-2 hours before lunch was confirmed to have a significant correlation with higher productivity in writing.

Time—The Missing Element in School Scheduling

In the past several decades, many research efforts have been devoted to investigating the relationship between school scheduling systems and academic performance. Among the rest, the majority focused on unlocking the time block in high school schedules from the traditional six or seven periods daily to alternative schedules with more demands on concentration and intensity for quality learning time, such as extending the class period time. Interestingly, although there remain critiques about the "excessively rigid" traditional school schedule, and some

alternative schedules are provided, the similarity of the daily schedule has not changed much from nearly a century earlier (Stranger, 2004). The National Education Association (1994) even makes the argument that a school schedule should meet learners' needs and "time" is the "missing element" in it across the United States. Certain possible reasons for this are that a different, better, and comprehensive model is still waiting to be developed, or just simply, that people have difficulty changing correspondingly.

Without a doubt, constructing a school timetable is a complicated and time-consuming process. Too many factors need to be considered and too much pressure will be imposed when dealing with conflicts and multiple considerations. Teachers and students' needs, instructional equipments, school routine activities, educational plans, technology and community, and staff expertise are some of the factors in this tough task (Tang, 1987). According to Schroth (1997), while the learner profiles and needs of students are the most important factors in deriving a timetable, practically, these are often overlooked due to the difficulty in integrating individual differences (Tang, 1987).

Productive Timing of Creativity

Krathwohl (1997) argues, "Clearly,… some pattern [that] is better for each of us, and we must find it" (p. 94), and encourages people to find their own most

productive conditions and when and where to work. Oldach (1995) also stresses the importance of one's own awareness of the most productive time during creative activities. However, as described earlier, few studies investigate the most productive moment of creativity. Among the few is the one conducted by Csikszentmihlyi, Rathunde, and Whalen (1993), in which people were asked to keep a record of the most productive moments for their inspiration activity along the creative process (see Kirschenbaum, 1998).

The only research closely related to the investigation of the most productive occurrence of timing for creativity was conducted by Sternberg and Lubart (1991). This study, however, was about occurrence timing in a lifetime. Their study shows that the most productive years for creativity are in the 20s and 30s. As highlighted by Coleman and Colbert (2001), "This has important implications for incorporating creativity theory into the college classroom" (p. 9). Following this thought, a further question arises: "What time (if any) is the most productive moment for creativity activities in a daily fashion?" Nevertheless, no literature addresses the issue of the most productive occurrence timing of creativity on a daily basis.

In summary, so far, no one has explored the effects of time of day on creativity performance. Beyond a doubt, a better understanding of this issue would provide educators and learners, particularly those in the art and design (creativity-related) fields with important clues about how to construct a better schedule of learning in

fostering creativity. To be more specific, in consideration of individuals' differences in learning rhythms, people in fields that are highly related to creativity deserve even more attention.

Chapter 3

Methods

This study aims to examine whether there is a cross-disciplinary difference in the relationship between time of day and creativity. A conceptual framework is delineated, research design and corresponding sampling approach are described, and appropriate analytical techniques are presented in this chapter.

Conceptual Framework

The intent of this study is to examine, from the time perspective of occurrence of creativity, whether there is a significant difference among students in different disciplines (i.e., creativity-highly-related and creativity-not-highly-related) in terms of self-perceived most and least creative times during the day; and whether there is a significant difference among students in different disciplines in terms of the relationship between school time intervals and creativity performance on fluency, flexibility, originality, and elaboration in idea generation tasks. Figure 3.1 is a diagrammatic conceptual framework for this study and delineates the possible relationships between time of day and the most and least creative moments, and between time of school day and creativity performance among students in different disciplines.

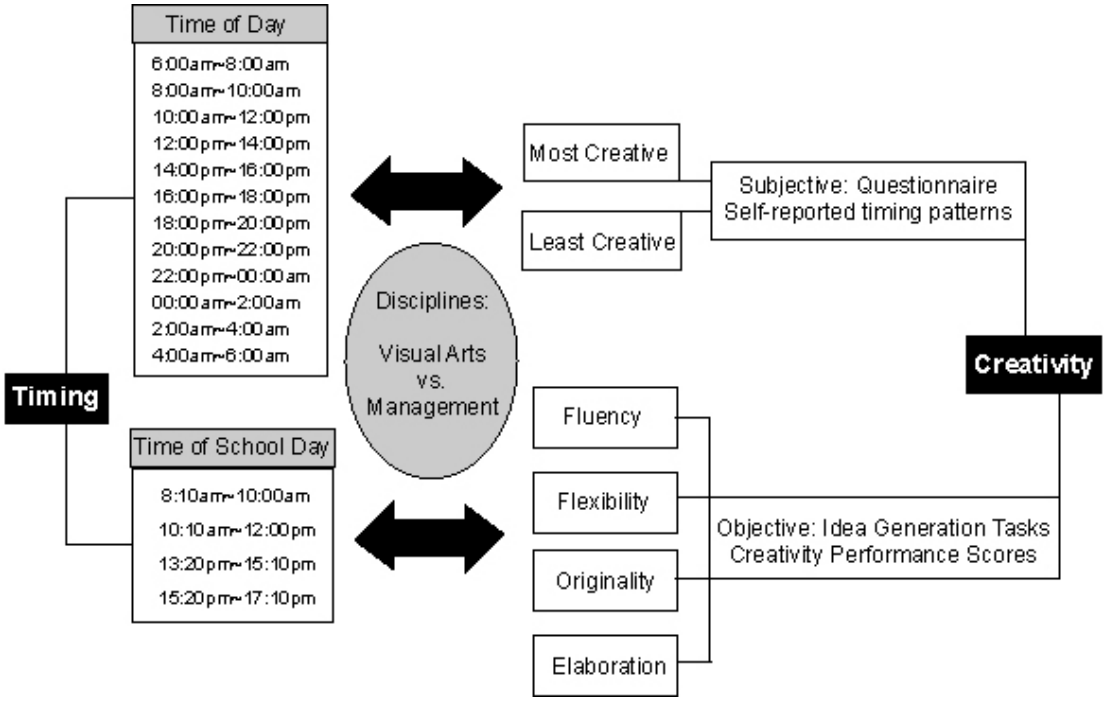


Figure 3.1. A conceptual framework of the research design

Research Design

This study is based on a cross-sectional design that involved two groups of college participants from different disciplines (i.e., Visual Arts and Management) who were willing to participate in this study and signed a consent form.

In order to compare the relationship between the creativity timing patterns and time intervals during the day between students in the two disciplines (research question 1), the two-hour time intervals around the clock and the two disciplines were employed as independent variables and the creativity timing pattern was used as the dependent variable. A questionnaire was distributed to each participant in

order to collect information on creativity timing patterns for each discipline.

On the other hand, in order to examine the effect of time of school day on creativity performance (research question 2) among students in the two disciplines, the four 2-hour class time intervals and the two disciplines were employed as independent variables and the creativity performance score was used as the dependent variable. Objective material, the idea generation tasks adapted from the Torrance Tests of Creative Thinking, was used to measure the fluency, flexibility, originality, and elaboration of creativity performance.

Sampling and Participants

This study was conducted during the Fall semester 2004. Basically, all students from two different disciplines (the Department of Computer-aided Media Design [visual arts field] vs. the Department of Health Care Administration [management field]) at Chang Jung University in Taiwan were targeted purposively for this study.

The eligible participants for this study included the students in the Department of Computer-aided Media Design (hereafter referred to as “Arts”) who signed the consent form, and a group of counterpart students from the Department of Health Care Administration (hereafter referred to as “Management”) based on certain matching criteria such as level, gender, and age. It was thus expected that through the appropriate matching approach, the two groups of participants would resemble

each other in certain basic characteristics except for discipline.

For the specific purpose of this study, the subsample of the arts people referred to those students in the arts program who thought they were appropriate for the field and who had ever dealt with creative tasks for at least “some times”; by the same token, the subsample of the management people referred to those students in the management program who thought they were appropriate for the field and who did not deal with creative tasks “very often.”

Originally, the eligible participants for this study were 481 students, including 230 from the arts program and 251 from the management program. Through the screening stage, 154 arts students and 143 management students were retained and were included in subsequent analyses. The range of age was from 18 to 23. About 33.8% were male and 66.2% were female among the arts students, and 23.1% were male and 76.9% were female among the management students.

Through a stratified sampling approach, all of the students from both fields were selected and assigned into one of the four school time intervals for surveys and for idea generation tasks (see Figure 3.2), according to their background information (i.e., discipline, grade level, and gender).

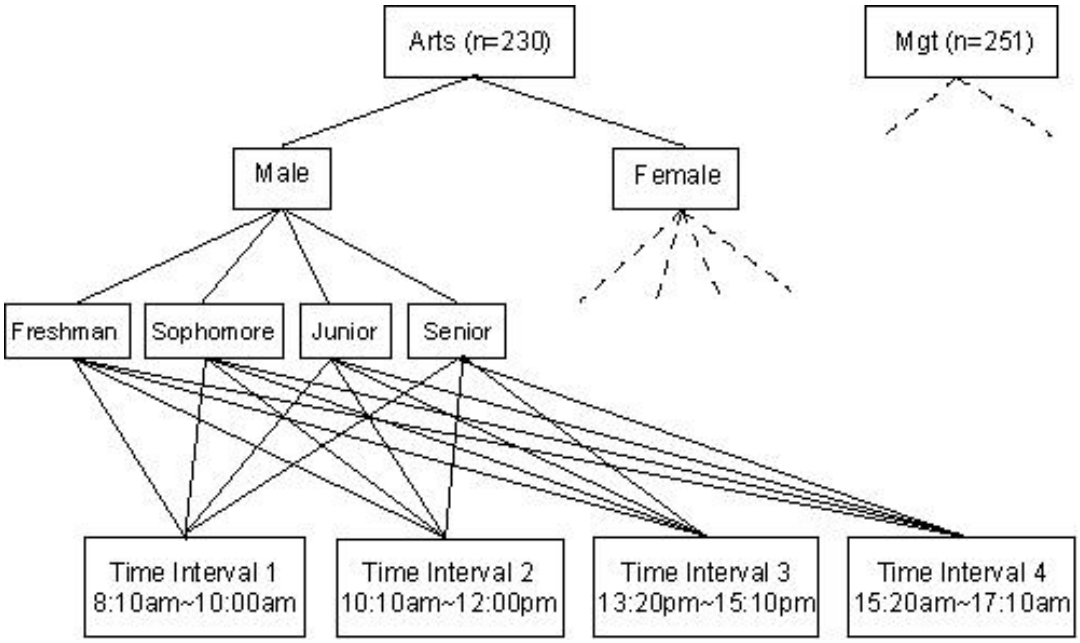


Figure 3.2. Assignment of participants into time intervals

Materials

Two major instruments were used to collect data for this study: a self-reported questionnaire (see Appendix A), and two idea generation tasks adapted from the TTCT verbal tests (see Appendix B).

The Structure of the Self-reported Questionnaire

Studies have confirmed that most college students can actually predict the modality in which they will demonstrate superior learning performance (e.g.,

Domino, 1970; Far, 1971), and are capable of self-classification into personal function of time of day (Thayer, 1967). Therefore, a self-reported questionnaire was constructed to elicit some basic information related to the participants' demographics as well as their self-perceived most and least creative time periods during the day (see Appendix A).

The self-reported questionnaire consists of 8 items. The first 4 items are about the participants' demographic information, including age, gender, academic level, and major. The other 4 items are further classified into two parts. The first part relates to creativity timing by asking the participant the time periods in which he/she feels most creative and least creative, respectively. The second part is designed to exclude inappropriate subjects in each specific field (visual arts vs. management) by asking the participant the frequency with which he/she deals with so-called creative tasks, and the self-rated appropriateness of study in the current discipline.

The Idea Generation Tasks

Two idea generation activities adapted from the TTCT (Torrance Tests of Creative Thinking) verbal test were used to measure creative thinking activity. In consideration of the main purpose of this study, performance on fluency, flexibility, originality, and elaboration of creativity was scored respectively. The two idea generation tasks are described below as they were provided to the participants.

Activity 1: Unusual Uses (cardboard boxes)

Most people throw their empty cardboard boxes away, but they have thousands of interesting and unusual uses. In the spaces below, list as many of these interesting and unusual uses as you can think of. Do not limit yourself to any one size of box. You may use as many boxes as you like. Do not limit yourself to the uses you have seen or heard about; think about as many possible new uses as you can.

Activity 2: Product Improvement

In the middle of this page is a sketch of a monkey of the kind you can buy in most dime stores for about one to two dollars. It is about six inches tall and weighs about six ounces. In the spaces on this page and the next one, list the cleverest, most interesting and unusual ways you can think of for changing this toy monkey so that children will have more fun playing with it. Do not worry about how much the change would cost. Think only about what would make it more fun to play with as a toy.

The participant's performance of creativity on the fluency, flexibility, originality, and elaboration in the idea generation tasks was evaluated with the aid of

the TTCT scoring guide. Certain issues and concerns related to the TTCT tests are described below, as quoted in the TTCT tests, to help people better understand the instrument.

According to Heausler and Thompson (1988), the Torrance Tests of Creative Thinking (1966) are probably among the most frequently used instruments in assessing creativity (Clapham, 1998). While several studies (Chase, 1985; Davis, 1989; Saeki, Fan, & Dusen, 2001) express concerns about the reliability and validity of TTCT, they also conclude that the TTCT are to a certain extent reliable with typical test-retest reliability of about 0.70, and inter-rater reliabilities mostly above 0.90. Further, in an attempt to relieve concerns about the validity of the TTCT, Torrance (1990) also provides several types of validity evidence, which, generally speaking, demonstrates the justification of validity examination.

Certain issues and concerns related to the TTCT tests are described below, as quoted in the TTCT tests, to help people better understand the instrument.

1. Who can score the Creative Thinking Tests?

> “These findings suggest that it is not necessary to have special training in scoring these tests to assure reliable results. What does appear to be necessary is that the scorers read and follow the scoring guide as precisely as possible, accepting the standards of the guide as a basis for judgment.” (Torrance, 1974, Verbal Form A, p. 10)

2. Creative thinking “activity” or “exercise”

“Examiners should note that the word ‘test’ has not been used on the booklet nor in the printed instructions….the use of a word ‘activity’ or “exercise” is suggested.…the expectation that examinees will enjoy the activities and invite them to ‘have fun’.” (Torrance, 1974, Verbal Form A, p. 2)

3. Definition of creativity

“….a process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies: testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results.” (Torrance, 1990, p. 8)

4. Correlations among activities

“….no effort was made to select activities that would be highly correlated with one another. (Torrance, 1974, Verbal Form A, p. 10)”

Procedures

The research process for this study may be diagrammatically delineated as shown in Figure 3.3. Each major stage is described briefly.

First, the researcher received approvals and permission from the Departments

of CAMD (Arts) and HCA (Management) to conduct research activities during class periods in the beginning week of the Fall semester 2004. Also, the request to access students' basic information was approved by the Division of Admissions.

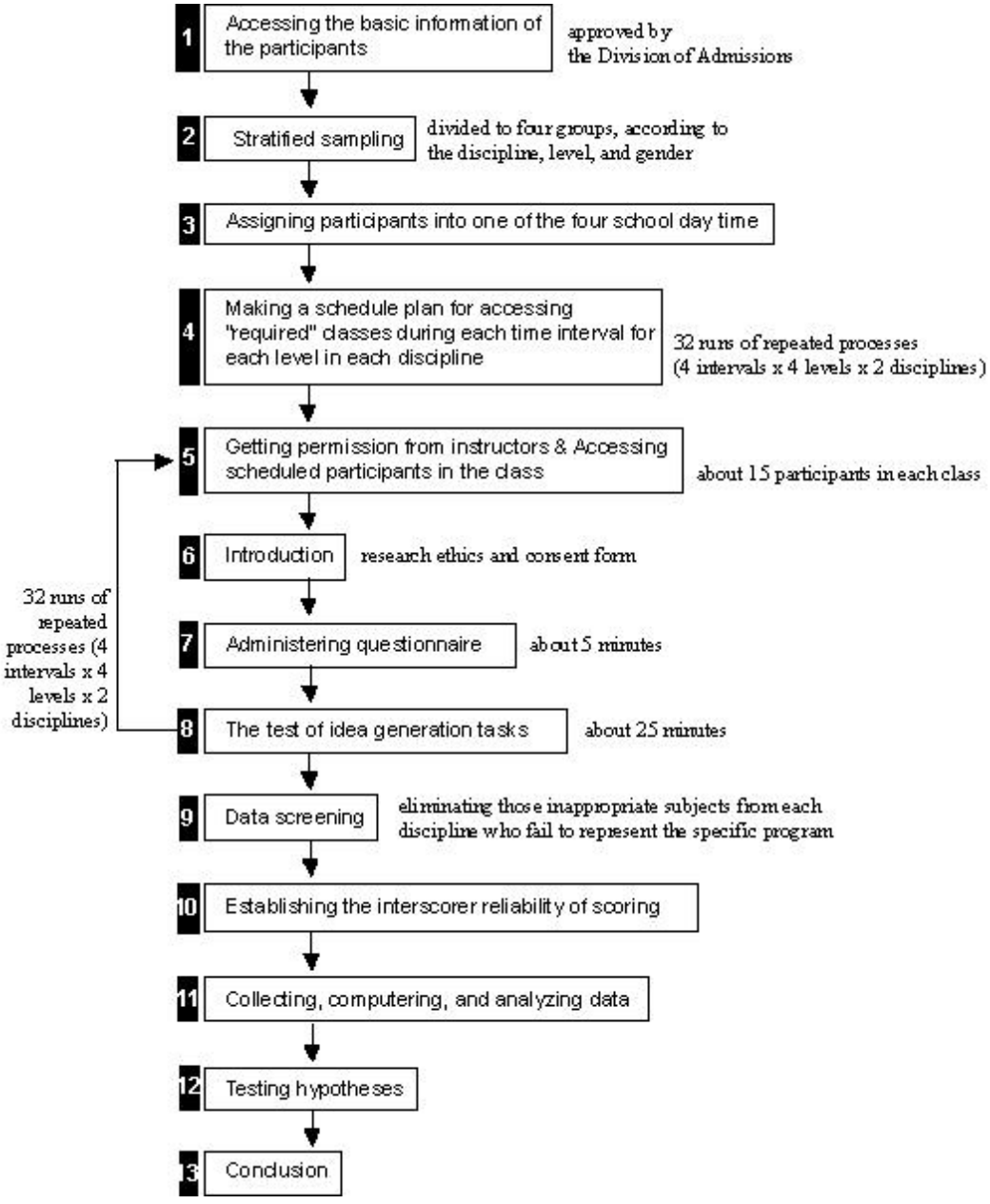


Figure 3.3. A flowchart of the research process

Further, in order to make sure most of the students in the two programs would show up during the same class time period and to avoid possible discrepancies in students' interest in selected courses, this study used only required courses in arranging for research activities. For each discipline, a research-conduct plan was scheduled in advance by matching the "required courses" schedules with the four school time intervals during the first week of the semester. The major concern was to try to lessen interference with regular class activities as much as possible. A specific scheduling plan was prepared for each level (i.e., freshman, sophomore, junior, and senior) in the two departments, respectively.

When it was ready, the researcher obtained permission from the instructors to access their class students in the first 30 minutes of class.

After sufficient numbers of participants at each time interval were recruited, they were provided with important information regarding research ethics and the necessity of obtaining a signed consent form.

The researchers then distributed the questionnaires and the idea generation tasks tests to those participants who signed the consent forms within each specific group based on a stratified sampling approach in the class. Research activities lasted about 30 minutes, with 5 minutes for the questionnaire and 25 minutes for the idea

generation tasks. Similar procedures were repeated for the other three time intervals for each level in each discipline throughout the research process. In other words, there were 16 (4 levels x 4 intervals) repeated investigation procedures for each discipline (see Figure 3.3).

After all of the data were collected, the researcher eliminated inappropriate subjects from sample pools based on the questions that asked whether they perceived themselves fitting into the current program, or how often they dealt with so-called creativity tasks.

Finally, three scorers were recruited to grade the idea generation tasks—two from academic fields who had experience in teaching "creative thinking" courses for at least two years and were familiar with the TTCT (same background as the researcher), and one from a design field who had been a senior creative director for more than seven years. In order to assure reliability of scoring, the inter-rater reliability was tested, although the developer of the TTCT claimed that "…the intercorrelations have been rather consistently above .90 and there have been only very small differences in means" (Torrance, 1974, Verbal Form A, p. 17).

Following the process suggested by Torrance (1974), the researcher asked the scorers to read the scoring manual carefully first and to score a set of 10 tests each. Then, the scorings were compared and differences discussed. After this, a set of 30 tests was given to each scorer. The results showed that all coefficients of correlation

were high except for originality (fluency, .99; flexibility, .94; originality, .92; and elaboration, .94), and no statistically significant difference was found in the means. Since the inter-scorer reliabilities were found to be sufficiently high, subsequent time-consuming and effort-taking scoring tasks were executed by the only scorer who was relatively available in terms of time constraint.

Definition of Variables

The variables used for the analysis may be classified into four categories: demographics, subjective self-perceptions, timing, and objective creativity performance. Briefly, demographic variables include respondents' biological characteristics and educational background. Subjective self-perception variables ask respondents at what time intervals he/she thinks he/she is most (or least) creative, and how often he/she deals with creativity-related tasks. The variable timing is about school time intervals. And, objective creativity performance variables include the four dimensions of creativity, that is, fluency, flexibility, originality, and elaboration.

Operational definitions and measures of variables are presented in Table 3.1.

Table 3.1.

Operational Definitions and Measures of Variables

Variables	Operational Definitions	Measures
Demographics		
Age	Age in years as of the month of test	Continuous variable, to one decimal

Table 3.1 cont'd.

Variables	Operational Definitions	Measures
Gender	Gender	Dichotomous variable 0=Male 1=Female
Level	The current academic year in program	Categorical variable 1= Freshman 2= Sophomore 3= Junior 4= Senior
Discipline	Academic background of the student who thought he/she was appropriate for the specific program and: (1) for the arts program, who had dealt with creativity tasks at least for "some times;" (2) for the management program, who	Dichotomous variable 1= Art 2= Management

	didn’t deal with creativity tasks “very often”	

Table 3.1 cont’d.

Variables	**Operational Definitions**	**Measures**
Self-perception (Subjective)		
Creativity timing (most)	A participant’s perception of most creative timing during the day	Categorical variable 0= Don’t know 1= 06 a.m.~08 a.m. 2= 08 a.m.~10 a.m. 3= 10 a.m.~12 p.m. 4= 12 p.m.~02 p.m. 5= 02 p.m.~04 p.m. 6= 04 p.m.~06 p.m. 7= 06 p.m.~08 p.m. 8= 08 p.m.~10 p.m. 9= 10 p.m.~12 a.m. 10= 12 a.m.~02 a.m. 11= 02 a.m.~04 a.m. 12= 04 a.m.~06 a.m.
Creativity timing (least)	A participant’s perception of least creative timing during the day	Categorical variable 0= Don’t know 1= 06 a.m.~08 a.m. 2= 08 a.m.~10 a.m. 3= 10 a.m.~12 p.m. 4= 12 p.m.~02 p.m. 5= 02 p.m.~04 p.m.

		6= 04 p.m.~06 p.m. 7= 06 p.m.~08 p.m. 8= 08 p.m.~10 p.m. 9= 10 p.m.~12 a.m. 10= 12 a.m.~02 a.m. 11= 02 a.m.~04 a.m. 12= 04 a.m.~06 a.m.

Table 3.1 cont'd.

Variables	**Operational Definitions**	**Measures**
Creative task experience	A participant's perception of how often he/she deals with creative tasks in daily life	Categorical variable 0= Never 1= Seldom 2= Sometimes 3= Average 4= Often 5= Very often
Appropriateness	A participant's perception of whether art/mgt is an appropriate field for him/her	Categorical variable 0=No 1=Yes
Timing		
School time intervals	08:10 a.m. to 10;00 a.m., 10:10 a.m. to 12:00 p.m., 13:20 p.m. to 15:10 p.m., and 15:20 p.m. to 17:10 p.m., four intervals, around 2-hours per interval, during	Categorical variable 1= 8:10 a.m.~10:00 a.m. 2= 10:10 a.m.~12:00 a.m. 3= 13:20 p.m.~15:10 p.m.

	a school day.	4= 15:20 p.m.~17:10 p.m.

Table 3.1 cont'd.

Variables	**Operational Definitions**	**Measures**
<u>Creativity performance (Objective)</u>	The generated creative ideas evaluated by others via fluency, flexibility, originality, and elaboration	
Fluency	Torrance creativity measure for fluency based on the quantity of responses to stimuli	Continuous variable 0 -- Max
Flexibility	Torrance creativity measure for flexibility based on the quantity of categories of responses to stimuli	Continuous variable 0 – 29 (for task 1) 0 – 24 (for task 2)
Originality	Torrance creativity measure for originality based on the uniqueness of the responses that are statistically	Continuous variable 0 -- Max (0 -- 2 for each individual response)

	infrequent	
Elaboration	Torrance creativity measure for elaboration based on the imagination and exposition of detail to stimuli	Continuous variable 0 -- Max (0 -- 3 for each individual response)

Analytical Approach

After all necessary data (questionnaires and idea generation tasks sheets) had been collected, appropriate analytical approaches were then implemented for data analysis, which included descriptive analysis and inferential analysis. Appropriate diagrams with the aid of spreadsheet software package (e.g., Microsoft Excel) were also used to visually display the profiling of relevant characteristics.

In this study, the analytical tools were the popular software packages SPSS 12.0 and Microsoft Excel. The significance level was set at $p = 0.05$ for statistical analyses.

Descriptive Analysis

Descriptive analysis was mainly used to provide a profiling of the participants with regard to demographic characteristics such as age, gender, and educational background collected from the questionnaires. In addition, a brief description of the

results from testing on the idea generation tasks was provided through descriptive analysis.

Specifically, the descriptive techniques for this study included the following statistics:

1. Means and standard deviations—age, scores on idea generation tasks; and
2. Frequencies and percentages—distributions of gender and level, self-perceived most/least creative times, and so on.

Inferential Analysis

Inferential analyses were used to examine the statistics of interest to see whether any significant differences existed across time intervals and/or between the two disciplines of concern.

Chi-square Tests

As mentioned earlier, around-the-clock day time was divided into 12 time intervals (i.e., 2 hours per time interval) for the study. Based on the participants' self-perceptions of the most and least creative times of day, the distribution of frequency (percentages) among the 12 different time intervals and the two disciplines was tabulated. To examine whether any significant cross-disciplinary difference existed, a chi-square test was performed.

Two-way Analysis of Variance

To examine whether significant cross-disciplinary differences existed in terms of the effects of time of school day on creativity performance, two-way analysis of variance along with post hoc testing was performed to determine the interaction effect (if any) of the independent variables (i.e., disciplines and the four school time intervals) on the performance scores for fluency, flexibility, originality, and elaboration in the idea generation tasks. Since there were four dimensions of creativity (i.e., fluency, flexibility, originality, and elaboration), four individual runs of two-way ANOVA analysis were conducted.

One-way Analysis of Variance

To examine whether significant differences existed in creativity performance across school time intervals for each discipline, one-way analysis of variance along with post hoc testing was implemented. Since there were four dimensions of creativity (i.e., fluency, flexibility, originality, and elaboration), eight runs of one-way ANOVA analysis (four runs for each discipline) were conducted.

Chapter 4

Results

In this chapter, the main purpose is to interpret and discuss the results generated through the statistical analysis. Descriptive analyses, chi-square, and two-way analyses of variance were employed and discussed to help readers better understand the study results.

Descriptive statistics are presented to illustrate the background characteristics of the study sample and the distributions of study variables in order to give the readers an initial look at the findings from this research. In the second section, two-way analysis of variance analyses were performed to determine the interaction effects of the independent variables (i.e., department and school time intervals) in relation to idea generation task performance. A chi-square procedure was completed to test whether the distributions of self-perceived most-creative times were significantly different between the two departments of interest. A summary of statistical findings is provided at the end of this chapter.

Descriptive Statistics

There are two parts to this section—the background characteristics of the study

sample and score distributions in each discipline.

Background Characteristics of the Study Samples

As mentioned in chapter 3, originally, 256 college students from the Department of Computer-aided Media Design (Arts) and 350 from the Department of Health Care Administration (Management) at Chang Jung University (CJU) in Taiwan were targeted for this study. Among them, 481 participants signed the consent form, 230 from the Arts and 251 from Management, and were treated as eligible subjects.

After the data screening process to purposively eliminate all subjects who thought themselves inappropriate to study in their current programs, and those who responded “seldom” to the question about conducting creativity-relevant tasks in the Arts and, conversely, those who responded “very often” in the Management (with the response scale ranging from “very often” [1] to “seldom” [5]), 297 study subjects were retained in the final data set for subsequent analyses, with 154 from the Arts and 143 from Management.

A statistical description of the characteristics (numbers of observations, percentages, means, and standard deviations) for the screened study sample is provided in Table 4.1.

Table 4.1.

Statistical Description of Characteristics for the Study Sample

Variable	**Arts** (N=154)		**Mgt** (N=143)		*p*_value
	N (%) or Mean	S.D.	N (%) or Mean	S.D.	
Age	20.0	1.67	19.6	1.33	0.012*
Gender					
0: Male	52 (33.8%)		33 (23.1%)		0.042*
1: Female	102 (66.2%)		110 (76.9%)		
Level					
1	53 (34.4%)		51 (35.7%)		0.135
2	35 (22.7%)		45 (31.5%)		
3	33 (21.4%)		29 (20.3%)		
4	33 (21.4%)		18 (12.6%)		
Performance score in creativity tasks					
Fluency	11.25	6.36	8.90	5.92	0.001***
Flexibility	5.65	2.28	4.45	1.88	0.000***
Originality	7.27	4.09	4.66	3.42	0.000***
Elaboration	2.86	2.38	1.70	0.93	0.011*

* 0.05 level of significance

*** 0.001 level of significance

Briefly speaking, while the mean ages of subjects were close to 20 (20.0 for the Arts vs. 19.6 for Management), the difference reached statistical significance (p=0.012). More than one third (33.8%) of the Arts subjects were male as opposed to less than one fourth (23.1%) of the Management, which also reveals a statistically significant difference (p=0.042). As for the distributions of subjects across academic levels, among the Arts study subjects, more than one third (34.4%) were freshmen,

with the rest nearly equally split among sophomores, juniors, and seniors (22.7%, 21.4%, and 21.4%, respectively). On the other hand, among the Management study sample, about one third of the subjects fell into the freshman and sophomore categories (35.7% and 31.5%), leaving 20.3% to the junior and 12.6% to the senior levels. Note that there is no statistically significant difference (p=0.135) in the distributions of subjects across different grade levels between the two disciplines.

Performance Score on Idea Generation Tasks

As demonstrated by the mean scores and standard deviations for creativity performance on the idea generation tasks, the Arts students outperformed their counterparts, the Management students (see Table 4.1). The mean fluency performance score for the Arts was 11.25, compared to 8.90 for Management (p=0.001). The flexibility scores (5.65 for the Arts and 4.45 for Management) and the originality scores (7.27 for the Arts and 4.66 for Management) both showed a statistically significant difference at the 0.0001 level between the two disciplines. As for the elaboration scores (2.86 for the Arts and 1.70 for Management), the difference between the two programs also reached statistical significance with a p-value of 0.011.

Empirical Results

Distribution of Self-perceived Most and Least Creative Times

Hypothesis 1-1: There is no statistically significant difference between arts and management college students in terms of time patterns for the most creative time intervals during the day.

Hypothesis 1-2: There is no statistically significant difference between arts and management college students in terms of time patterns for the least creative time intervals during the day.

Research has confirmed that certain periods of time during the day are better than other periods for doing specific things. Further investigation should be done on whether these “certain periods” in time would vary by people with different characteristics (e.g., “arts” people vs. “management” people).

As shown in Table 4.2, the Arts participants were more likely to “have” their “day” begin at 20:00 p.m.; 7.1% of subjects viewed it as the most creative time interval. When it came to the time interval of 22:00 p.m.~0:00 a.m., the percentage increased to 15.6%; it reached the peak at the time interval of 0:00 a.m.~2:00 a.m. with a percentage of 16.2%. After the peak, the percentage dropped quickly to 5.8% (2:00 a.m.~4:00 a.m.). On the other hand, the Management participants seemed to start their “day” early, at 8:00 a.m., with 7.7% of subjects viewing this as the most creative time interval during the day. The percentage kept rising to 8.5% at the time

interval of 10:00 p.m.~12:00 p.m. Then, the percentages stayed low at around 3.5~5.6% until the time interval of 20:00~22:00 pm, which in fact was also the peak with a percentage of 14.7%. Next to the peak was the time interval of 22:00 p.m.~0:00 a.m. with a percentage of 12.6%. The percentage dropped sharply to 5.6% (0:00 a.m.~02:00 a.m.), and even to 1.4% at the interval of 2:00 a.m.~4:00 a.m. One third or so of responses indicated “no preference” in terms of self-perceived most creative time intervals within each discipline. Figure 4.1 is the diagrammatic presentation for the distributions of self-perceived most creative times.

Table 4.2.

Distributions of Self-perceived Most Creative Times

Variable	**Arts** (N=153) N (%)	**Mgt** (N=142) N (%)	*p*_Value
***Self-perception of the most creative time intervals**			0.001*
6:00~8:00 **a.m.**	5 (3.2%)	2 (1.4%)	
8:00~10:00	9 (5.8%)	11 (7.7%)	
10:00~12:00 **p.m.**	5 (3.2%)	12 (8.5%)	
12:00~14:00	6 (3.9%)	2 (1.4%)	
14:00~16:00	2 (1.3%)	5 (3.5%)	
16:00~18:00	2 (1.3%)	8 (5.6%)	
18:00~20:00	2 (1.3%)	5 (3.5%)	
20:00~22:00	11 (7.1%)	21 (14.7%)	
22:00~00:00 **a.m.**	24 (15.6%)	18 (12.6%)	
00:00~2:00	25 (16.2%)	8 (5.6%)	
2:00~4:00	9 (5.8%)	2 (1.4%)	
4:00~6:00	2 (1.3%)	2 (1.4%)	
“No preference”	51(33.1%)	48 (33.6%)	

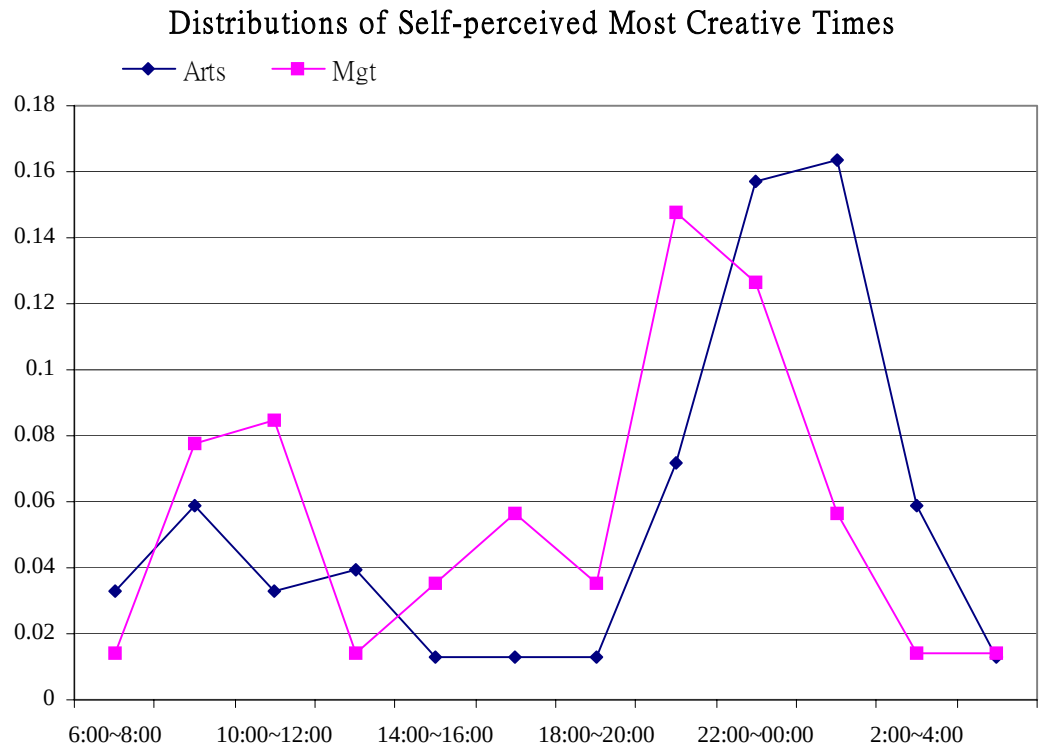


Figure 4.1. Diagram for the distributions of self-perceived most creative times

From a different perspective, the percentage of Arts participants who preferred to conduct creativity-related activities after midnight was 22%, more than 3 times that for the Management participants (7%). On the other hand, 12.7% of the Management participants perceived themselves as being relatively more creative after 14:00 p.m. through 20:00 p.m., as opposed to 3.9% in the Arts. In addition, although the management participants had their percentage peak at the interval of

20:00 p.m.~22:00 p.m. (14.7%), there were still 16.2% (7.7% for the interval of 8:00~10:00 and 8.5% for 10:00~12:00) of respondents who declared their most creative time was in the morning. Further, during the time period of 10:00 a.m.~12:00 p.m., the Management people were nearly three times more likely than the Arts people to declare themselves relatively more creative.

With regard to the self-perceived least creative times (see Table 4.3), about 30% of participants in both disciplines declared the time interval 6:00~8:00 am, followed by the time intervals 12:00 p.m.~14:00 p.m. (7.8% for the Arts vs. 9.8% for the Management). The time interval 4:00 a.m.~6:00 a.m. was another "least creative time" for the Arts (7.8%), while for Management, the percentages stayed around 5.6%~7.7% in the time interval after midnight through 6:00 a.m. Statistically, the difference in the distributions between the two disciplines was not significant. Figure 4.2 is the diagrammatic presentation for the distributions of self-perceived least creative times.

Table 4.3.

Distributions of Self-perceived Least Creative Times

Variable	**Arts** (N=153) N (%)	**Mgt** (N=142) N (%)	*p*_value
***Self-perception of the most creative time intervals**			0.664
6:00~8:00 **a.m.**	46(29.9%)	44 (30.8%)	
8:00~10:00	11 (7.1%)	5 (3.5%)	
10:00~12:00 **p.m.**	4 (2.6%)	4 (2.8%)	
12:00~14:00	12 (7.8%)	14 (19.8%)	
14:00~16:00	7 (4.5%)	7 (4.9%)	
16:00~18:00	2 (1.3%)	2 (1.4%)	
18:00~20:00	3 (1.9%)	2 (1.4%)	
20:00~22:00	0 (0%)	0 (0%)	
22:00~00:00 **a.m.**	2 (1.3%)	2 (1.4%)	
00:00~2:00	5 (3.2%)	11 (7.7%)	
2:00~4:00	8 (5.2%)	9 (6.3%)	
4:00~6:00	12 (7.8%)	8 (5.6%)	
“No preference”	42 (27.3%)	35 (24.5%)	

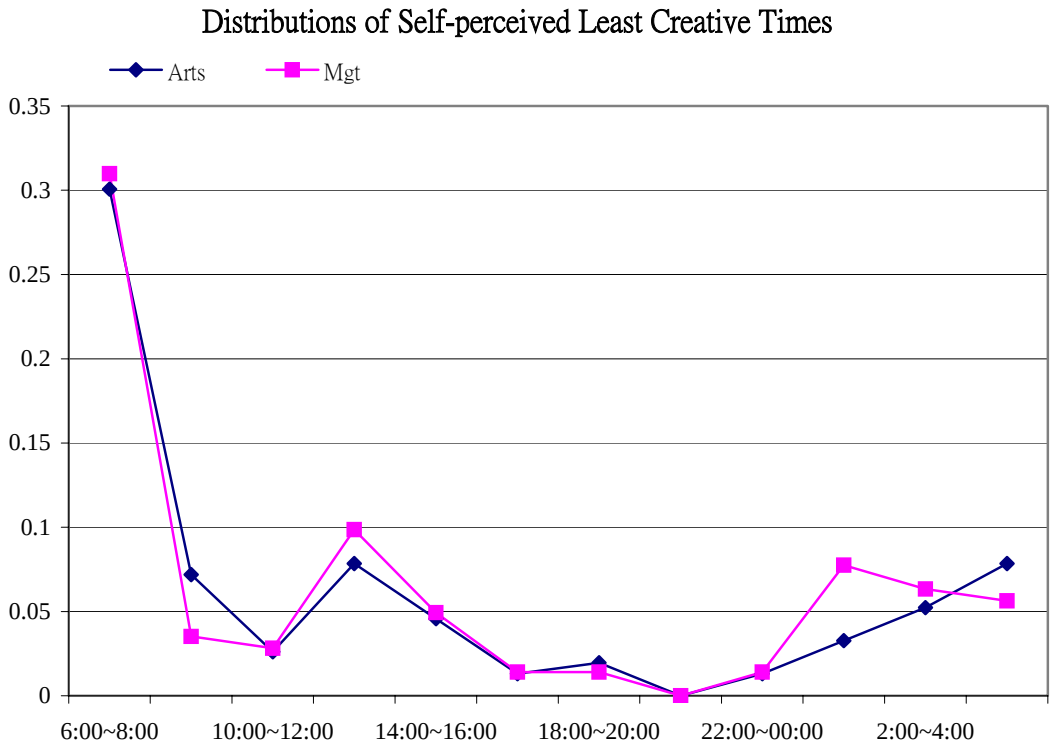


Figure 4.2. Diagram for the distributions of self-perceived least creative times

To a certain extent, these results indicate that these two specific groups of people value the time intervals during the day differently for their creativity activities. A further examination by statistical testing confirmed the aforementioned findings. In other words, there exists a statistically significant difference among college students between the Arts and the Management programs with regard to the time interval in which they feel most creative. As for the self-perceived least creative times, the result shows no statistically significant difference between the two

disciplines. In summary, Hypothesis 1-1 is not supported and Hypothesis 1-2 is supported.

Idea Generation Tasks Performance

Hypothesis 2: There is no statistically significant difference between Arts and Management college students in the effect of time of school day on creativity performance.

As indicated by the earlier results, the time intervals in a day that are perceived to be relatively better for creative people than other intervals vary by people's characteristics. The next question is whether the argument remains the same in terms of the effect of time of school day on creativity performance. Put differently, would people with different characteristics (Art vs. Management) have different performance patterns across the time intervals of school day?

Since creativity performance is comprised of four categories (fluency, flexibility, originality, and elaboration), Hypothesis 2 can be further divided into the four sub-hypotheses listed below.

Hypothesis 2-1a: There is no statistically significant difference between arts and management college students in the effect of time of school day on creativity performance for fluency in idea

generation tasks.

Hypothesis 2-1b: There is no statistically significant difference between arts and management college students in the effect of time of school day on creativity performance for flexibility in idea generation tasks.

Hypothesis 2-1c: There is no statistically significant difference between arts and management college students in the effect of time of school day on creativity performance for originality in idea generation tasks.

Hypothesis 2-1d: There is no statistically significant difference between arts and management college students in the effect of time of school day on creativity performance for elaboration in idea generation tasks.

In order to examine the interaction effect of school time intervals (8:10 a.m.~10:00 a.m., 10:10 a.m.~12:00 p.m., 13:20 p.m.~15:10 pd.,. and 13:20 p.m.~15:10 p.m.) and disciplines (art and management departments) on creativity performance of fluency, flexibility, originality, and elaboration in idea generation tasks, two-way analyses of variance were conducted.

Creativity Performance of Fluency

Table 4.4 provides the results of the two-way ANOVA analysis on creativity performance of fluency in idea generation tasks. Results indicate that there is a statistically significant interaction effect with $p = .007$.

Table 4.4.

Results of Interaction Effect on Idea Generation Task Performance for Fluency

Source	S.S.	df	M.S.	F	P_Value
Dept.	303.401	1	303.401	8.242	0.04*
Time Intervals (TI)	56.874	3	18.958	0.515	0.672
Dept. x TI	458.615	3	152.872	4.153	0.007**
Total	41983	297			

* 0.05 level of significance

** 0.01 level of significance

Further, as demonstrated in Figure 4.3, for the two disciplines, the relations between fluency performance and the first two time intervals were in opposite directions and there was an intersection between Time 1 and Time 2. Moreover, for the Arts discipline, fluency performance reached its peak (Mean=13.57) at Time 3 (13:20~15:10 pm), whereas the Management came down to its lowest performance (Mean=7.44) at the corresponding interval. In a word, the variations in fluency performance for idea generation tasks in the time intervals of the school day are significantly affected by the factor of discipline.

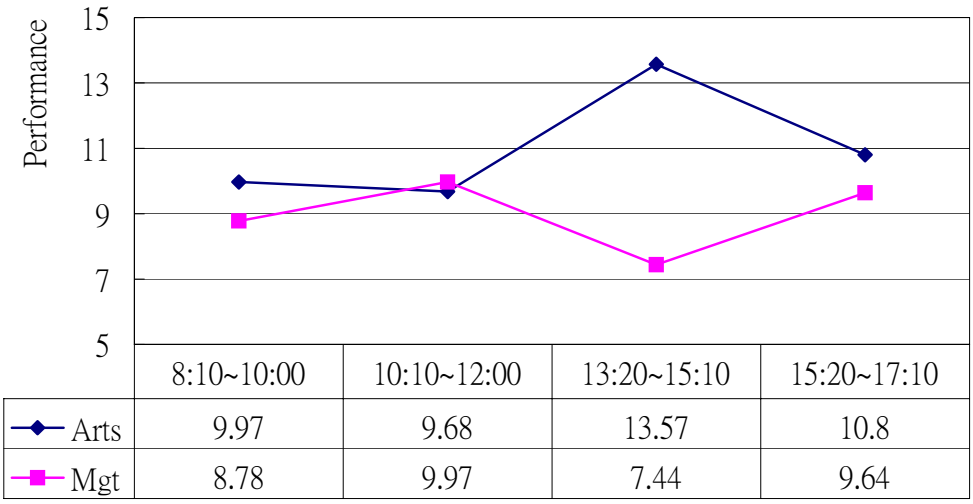


Figure 4.3. Means of fluency performance in idea generation tasks in each discipline

Creativity Performance of Flexibility

Similarly, Table 4.5 provides the results of the two-way ANOVA analysis for the creativity performance of flexibility in idea generation tasks. Findings indicate that no statistically significant interaction effect exists between the two factors of discipline and time interval (p=0.141).

Table 4.5.

Results of Interaction Effect on Idea Generation Tasks Performance for Flexibility

Source	S.S.	df	M.S.	F	P_Value
Dept.	95.055	1	95.055	21.674	0.000***
Time Intervals (TI)	4.611	3	1.537	0.350	0.789
Dept. x TI	24.169	3	8.056	1.837	0.141
Total	9062.000	297			

* 0.05 level of significance

*** 0.001 level of significance

As demonstrated in Figure 4.4, Time 3 remained the highest and the lowest performance time intervals for the Arts and Management, respectively. Further, while from Time 2 through Time 4, the relations between flexibility performance and time intervals were to some extent in opposite directions, the discrepancy did not reach statistical significance, nor did intersection occur, indicating that the variations in the fluency performance of idea generation tasks in the time intervals of the school day are not affected significantly by the differences between disciplines.

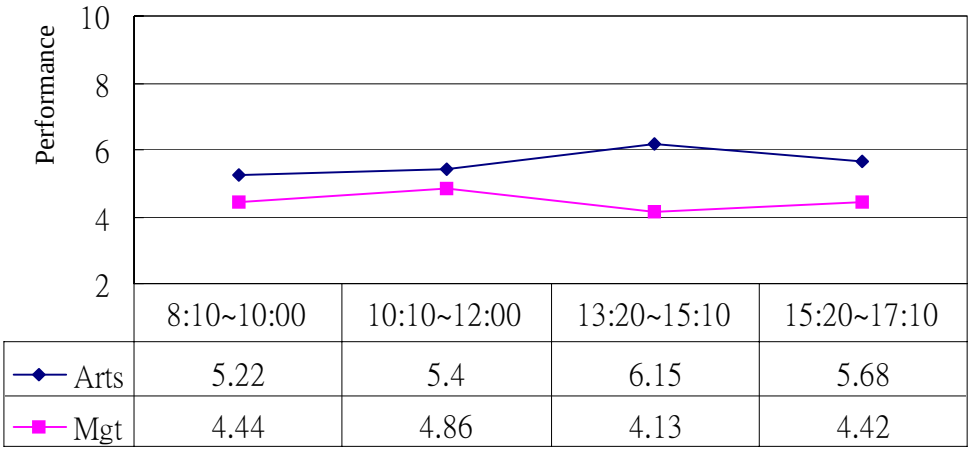


Figure 4.4. Means of flexibility performance in idea generation tasks in each discipline

Creativity Performance of Originality

In a similar way, Table 4.6 provides the results of the two-way ANOVA analysis for the creativity performance of originality in idea generation tasks. Findings indicate a statistically significant interaction effect with p=0.012.

Table 4.6.

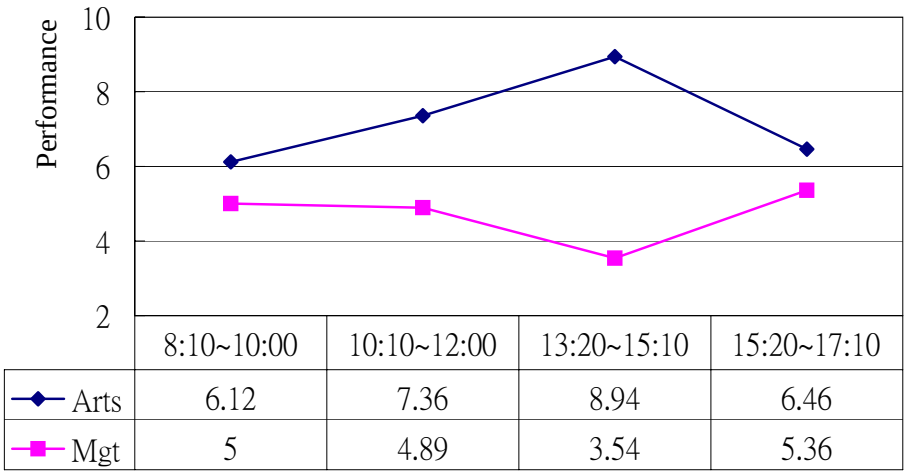
Results of Interaction Effect on Idea Generation Tasks Performance for Originality

Source	S.S.	df	M.S.	F	P_Value
Dept.	458.210	1	458.210	20.410	0.000***
Time Intervals (TI)	20.467	3	6.822	0.304	0.823
Dept. x TI	250.029	3	83.343	3.712	0.012*
Total	18018	297			

* 0.05 level of significance

*** 0.001 level of significance

Still, Time 3 remained to be the highest and the lowest performance time intervals for the Arts and Management, respectively, as demonstrated in Figure 4.5. Further, from Time 2 through Time 4, the relations between originality performance and time intervals were in opposite directions, similar to that displayed in Figure 4.4 but revealing a more significant discrepancy. Therefore, statistically speaking, the result indicates that the variations in originality performance of idea generation tasks in the time intervals of the school day are affected significantly by the factor of discipline.



	8:10~10:00	10:10~12:00	13:20~15:10	15:20~17:10
Arts	6.12	7.36	8.94	6.46
Mgt	5	4.89	3.54	5.36

Figure 4.5. Means of originality performance in idea generation tasks in each discipline

Creativity Performance of Elaboration

Finally, Table 4.7 provides the results of the two-way ANOVA analysis for

creativity performance of elaboration in idea generation tasks. Findings indicate that no statistically significant interaction effect exists between the two factors of discipline and time interval (P=0.425).

Table 4.7.

Results of Interaction Effect on Idea Generation Tasks Performance for Elaboration

Source	S.S.	df	M.S.	F	P_Value
Dept.	22.672	1	22.672	5.380	0.022*
Time Intervals (TI)	12.810	3	4.270	1.013	0.390
Dept. x TI	11.852	3	3.951	0.938	0.425
Total	1262	114			

* 0.05 level of significance

For the elaboration performance in idea generation tasks, Time 3 was the highest interval for the Arts, as opposed to Time 4 for Management (see Figure 4.6). In addition, the performance score kept increasing along the time intervals (from lowest at Time 1 through highest at Time 4) for Management. While the discrepancy patterns along the time intervals of school day looked somehow different, nevertheless, they did not sustain a significant interaction effect between the two factors of discipline and time interval.

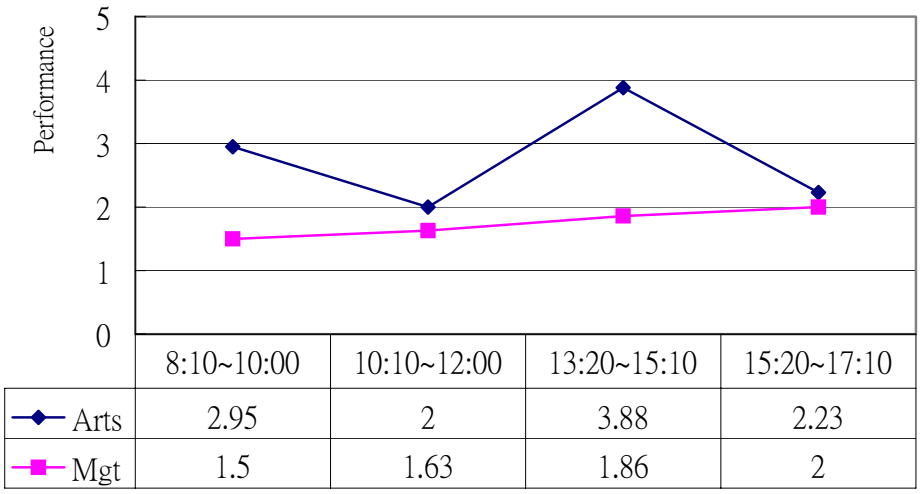


Figure 4.6. Means of elaboration performance in idea generation tasks in each discipline

In summary, based upon the results of the two-way ANOVA analyses, there exist significant ($p< 0.05$) interaction effects between disciplines and school time intervals on fluency and originality performances for idea generation tasks. Therefore, Hypotheses 2-1a and 2-1c are rejected. On the other hand, no significant interaction effects are found between disciplines and school time intervals for the flexibility performance or the elaboration performance in idea generation tasks. Therefore, Hypotheses 2-1b and 2-1d cannot be rejected.

Idea Generation Tasks Performance in the Arts Discipline

After the examinations of interaction effects for the two factors of discipline and school time intervals, we looked at the differences, if any, in the idea generation

task performance across school time intervals for students in any specific discipline. Relevant arguments for the Arts discipline are postulated as follows.

Hypothesis 2-2a: There is no statistically significant difference in the idea generation task performance of fluency across school time intervals for arts majors.

Hypothesis 2-2b: There is no statistically significant difference in the idea generation task performance of flexibility across school time intervals for arts majors.

Hypothesis 2-2c: There is no statistically significant difference in the idea generation task performance of originality across school time intervals for arts majors.

Hypothesis 2-2d: There is no statistically significant difference in the idea generation task performance of elaboration across school time intervals for arts majors.

Table 4.8 summarizes the results for creativity performance across school time intervals, according to one-way ANOVA analyses for participants in the Arts program. As indicated, except for flexibility performance (p=0.261), there is a significant difference in creativity performance across school time intervals.

Post hoc tests show that, generally speaking, Time 3 (13:20 p.m.~15:10 p.m.)

leads to relatively higher performance results than the other time intervals, and no significant differences are found between any other time intervals.

In summary, the Arts participants perform differently across school time intervals in the idea generation tasks on all but one (i.e., flexibility) categories. Therefore, hypotheses H2-2a, H2-2c, and H2-2d are rejected; on the other hand, Hypothesis 2-2b cannot be rejected.

Table 4.8.

Results of Creativity Performance across Time Intervals for the Arts Program

Variable	**N** (n=154)	**Mean**	**S.D.**	**F**	**P**	**Post Hoc**
Fluency						
1 = 08:10~10:00am	41	9.98	5.07	3.365	0.020**	3 > 1 3 > 2 3 > 4
2 = 10:10am~12:00pm	25	9.68	4.61			
3 = 13:20~15:10pm	47	13.57	8.14			
4 = 15:20~17:10pm	41	10.80	5.51			
Flexibility						
1 = 08:10~10:00am	41	5.22	1.62	1.347	0.261	
2 = 10:10am~12:00pm	25	5.40	2.38			
3 = 13:20~15:10pm	47	6.15	2.61			
4 = 15:20~17:10pm	41	5.68	2.35			
Originality						
1 = 08:10~10:00am	41	6.12	3.25	2.798	0.042*	3 > 1 3 > 4
2 = 10:10am~12:00pm	25	7.36	4.96			
3 = 13:20~15:10pm	47	8.94	4.19			
4 = 15:20~17:10pm	41	6.46	3.01			
Elaboration						
1 = 08:10~10:00am	20	2.95	1.82	2.925	0.039*	3 > 2 3 > 4
2 = 10:10am~12:00pm	16	2.00	1.03			
3 = 13:20~15:10pm	25	3.88	2.53			
4 = 15:20~17:10pm	22	2.23	1.45			

* 0.1 level of significance

** 0.05 level of significance

Idea Generation Tasks Performance in the Management Discipline

Similarly, the concerns for the differences, if any, in idea generation task performance across school time intervals for students in the Management discipline are raised with corresponding hypotheses postulated as follows.

Hypothesis 2-3a: There is no statistically significant difference in the idea generation task performance of fluency across school time intervals for management majors.

Hypothesis 2-3b: There is no statistically significant difference in the idea generation task performance of flexibility across school time intervals for management majors.

Hypothesis 2-3c: There is no statistically significant difference in the idea generation task performance of originality across school time intervals for management majors.

Hypothesis 2-3d: There is no statistically significant difference in the idea generation task performance of elaboration across school time intervals for management majors.

The results for creativity performance across school time intervals as shown in one-way ANOVA analyses for participants in the Management program are included

in Table 4.9. As indicated, no significant difference in creativity performance across school time intervals is found for any category. As a result, none of the hypotheses H2-3a, H2-3b, H2-3c, and H2-3d can be rejected.

Table 4.9.

Results of Creativity Performance across Time Intervals for the HCA Program

Variable	**N** (n=143)	**Mean**	**S.D.**	**F**	**P**
Fluency					
1 = 8:10~10:00am	36	8.78	5.31	1.361	0.257
2 = 10:10am~12:00pm	35	9.97	6.23		
3 = 13:20~15:10pm	39	7.44	4.72		
4 = 15:20~17:10pm	33	9.64	7.26		
Flexibility					
1 = 8:10~10:00am	36	4.44	1.76	0.929	0.428
2 = 10:10am~12:00pm	35	4.86	1.70		
3 = 13:20~15:10pm	39	4.12	1.94		
4 = 15:20~17:10pm	33	4.42	2.11		
Originality					
1 = 8:10~10:00am	36	5.00	4.07	1.219	0.305
2 = 10:10am~12:00pm	35	4.89	4.52		
3 = 13:20~15:10pm	39	3.54	2.92		
4 = 15:20~17:10pm	33	5.36	5.29		
Elaboration					
1 = 8:10~10:00am	10	1.50	0.70	0.412	0.746
2 = 10:10am~12:00pm	8	1.62	0.92		
3 = 13:20~15:10pm	7	1.86	1.07		
4 = 15:20~17:10pm	6	2.00	1.26		

Summary of Empirical Results

With regard to the self-perceived creative timing issues, the results show a statistically significant difference among college students between the two

disciplines in the distributions of most creative time period; nevertheless, no statistically significant difference is found in the distributions of least creative time patterns.

Further, among the four categories of creativity performance, two of them (i.e., fluency and originality) show significant interaction effects between the two factors of concern (i.e., school time interval and discipline) in both disciplines. On the other hand, the other two dimensions (i.e., flexibility and elaboration) have no significant interaction effect between the two factors of interest (i.e., school time interval and discipline) in both disciplines (see Figure 4.7).

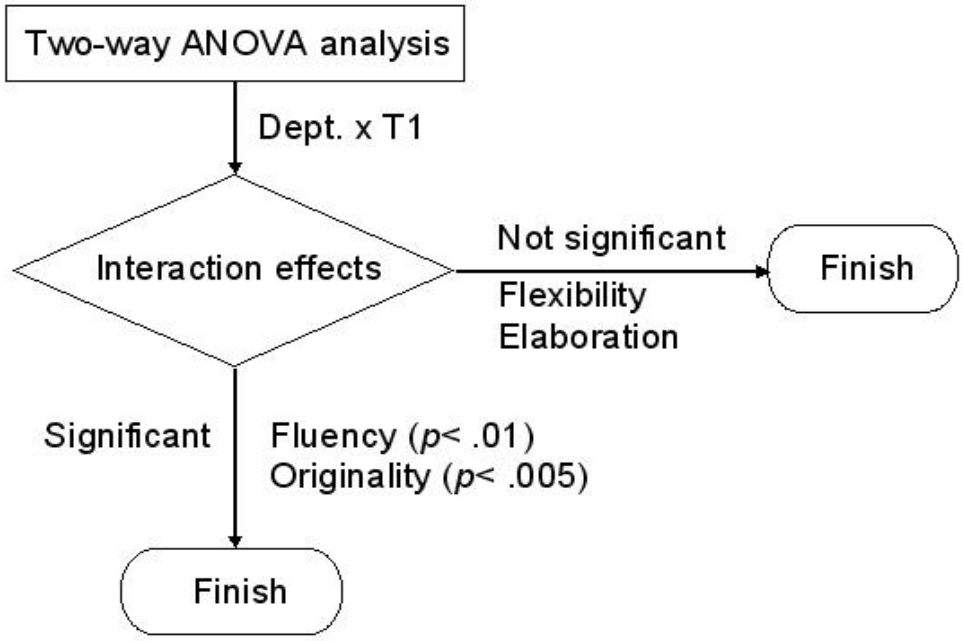


Figure 4.7. Diagrammatical illustration of two-way ANOVA analysis

Further analyses reveal that for the variable of fluency, the Arts participants have significantly higher performance scores in Time 3 than in the other three time intervals; for originality, the Arts participants also perform relatively better in Time 3, as opposed to Time 1 and Time 4. For the creativity of elaboration, the Arts participants still demonstrate better performance in Time 3 than in Time 2 and Time 4. As for flexibility, no statistically significant difference is found. On the other hand, the results of the one-way ANOVA show no significant difference in any category of creativity performance for the Management participants (see Figure 4.8).

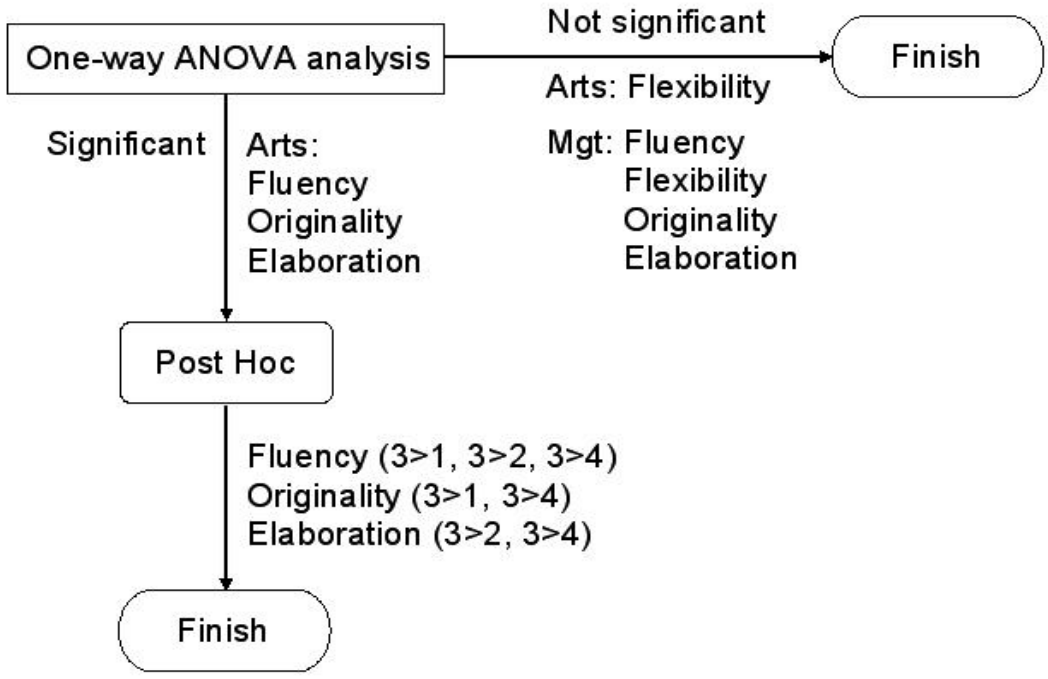


Figure 4.8. Diagrammatical illustration of one-way ANOVA analysis

The testing results for the hypotheses derived from the research questions of concern in this study are summarized and tabulated in Table 4.10 along with major findings in order to provide a thorough and clear overview of relevant issues.

Table 4.10.

Summary of Major Findings and Testing Results for Hypotheses

Hypothesis	**Major Findings**	**Testing Results**
H1-1	There is no statistically significant difference between arts and management college students in terms of time patterns for the most creative time intervals during the day.	Hypothesis Rejected
H1-2	There is no statistically significant difference between arts and management college students in terms of time patterns for the least creative time intervals during the day.	Hypothesis Accepted
H2-1a	There is no statistically significant difference between arts and management college students in the effect of time of school day on creativity performance for fluency in idea generation tasks.	Hypothesis Rejected
H2-1b	There is no statistically significant difference between arts and management college students in the effect of time of school day on creativity performance for flexibility in idea generation tasks.	Hypothesis Accepted
H2-1c	There is no statistically significant difference between arts and management college students in the effect of time of school day on creativity performance for originality in idea generation tasks.	Hypothesis Rejected
H2-1d	There is no statistically significant difference between arts and management college students in the effect of time of school day on creativity performance for elaboration in idea generation tasks.	Hypothesis Accepted

Table 4.10 cont'd.

Hypothesis	Major Findings	Testing Results
H2-2a	There is no statistically significant difference in the idea generation task performance of fluency across school time intervals for arts majors.	Hypothesis Rejected
H2-2b	There is no statistically significant difference in the idea generation task performance of flexibility across school time intervals for arts majors.	Hypothesis Accepted
H2-2c	There is no statistically significant difference in the idea generation task performance of originality across school time intervals for arts majors.	Hypothesis Rejected
H2-2d	There is no statistically significant difference in the idea generation task performance of elaboration across school time intervals for arts majors.	Hypothesis Rejected
H2-3a	There is no statistically significant difference in the idea generation task performance of fluency across school time intervals for management majors.	Hypothesis Accepted
H2-3b	There is no statistically significant difference in the idea generation task performance of flexibility across school time intervals for management majors.	Hypothesis Accepted
H2-3c	There is no statistically significant difference in the idea generation task performance of originality across school time intervals for management majors.	Hypothesis Accepted
H2-3d	There is no statistically significant difference in the idea generation task performance of elaboration across school time intervals for management majors.	Hypothesis Accepted

Chapter 5

Discussion and Conclusion

As noted in chapter 1, the main purpose of this research was to investigate and analyze the difference among individuals in arts and management fields in terms of daily time patterns for the most and the least creative time intervals. In addition, and perhaps more important, this research was interested in exploring the difference among arts and management people in the effects of time of day on creativity performance in idea generation tasks.

The interpretation of empirical results from this study is divided into two sections: distributions of self-perceived most creative and least creative time intervals, and interaction effects of discipline and time of day on creativity performance. A discussion of implications is then explored from the viewpoints of pedagogy, research, and industry and society. Limitations of the study design are then noted. Suggestions for future studies are provided at the end of this chapter.

Interpretation of Empirical Results

Briefly speaking, the core issues of this study are twofold: (1) From the participants' viewpoints solely, what are the distributions of most creative and least creative time intervals? And, (2) does there exist interaction effects of discipline and

time of day on creativity performance?

Distributions of Self-perceived Most Creative and Least Creative Time Intervals

The first research question explored is whether or not there is a significant difference among arts and management students in how they perceive themselves in terms of most creative and least creative time intervals during the day.

Self-perceived Most Creative Time Intervals

By the Chi-square analyses, the results seemed to provide strong evidence that there is a statistically significant difference among arts and management students in how they perceive themselves in terms of the most creative time intervals during the day. Three interesting things were found and worth discussing as follows.

First, the phenomenon of a relatively higher percentage of arts students preferring the time interval “after midnight” for creativity activities seems to reinforce the typical and almost irrefutable deep-rooted image of arts people as “night owls.” Further, it also seems to follow the assumption made earlier that, to some degree, a creative process involves more imagination and inspiration, which usually is fostered with and during solitude, visits with muse (Piirto, 1999), and the “Flow” experience (Csikszentmihalyi, 1997). Undeniably, there will be much more and better chances to fall into the “muse,” “solitude,” or “flow” situation after

“midnight” when most of the people around you are asleep. However, is the characteristic of falling into the “muse,” “solitude,” or “flow” situation during creative processes the major attribute for the creators’ “after midnight” timing pattern? Or, are there some other important factors that may contribute to the presence of this phenomenon? As far as this study is concerned, no satisfactory answer is provided. Nevertheless, this is truly a research question worthy of future exploration.

Second, Gate (1916) claims that forenoon is the best time for mental work. Some research has even declared that mid-morning (around 11:00 a.m.) is the period with peak efficiency for “most” students’ performance (Dunn, 1993), and the time period of 1-2 hours before lunch has shown significant correlation between writing scheduling and productivity among science and engineering faculty (Kellogg, 1986).

Consistent with the studies’ aforementioned findings, this study also showed that 10:00 a.m.~12:00 p.m. was the time interval in which highest percentage of management students felt most creative during the daytime (before 8:00 p.m.). Interestingly, the management people were nearly three times (8.5% vs. 3.2%) more likely than the arts people to declare themselves relatively more creative during the same time period of 10:00am~12:00pm, the “two hours before noon” time interval.

Therefore, the question here is: Is this because the management students have similar attributes to those of science and engineering faculty or even “most” students

while the arts students do not, which in turn makes them particularly different? A further study with more diverse attributes (programs) of participants would be necessary to clarify the relationship.

Third, although there existed certain variations in degree (i.e., percentage), the distribution of timing patterns for the two programs each (see Figure 4.1) revealed a negatively skewed curve with the majority falling into the time intervals after 8 p.m., which seemed to support study findings from Ishihara, Honma and Miyake (1990), in which it was concluded that university students were mostly evening-type persons.

Self-perceived Least Creative Time Intervals

According to results from the Chi-square analyses, surprisingly, there was no statistically significant difference among arts and management students in how they perceive themselves in terms of the least creative time intervals during the day (see Figure 4.2).

Interestingly but not surprisingly, both programs had the highest percentages during the early morning (6:00 a.m.~8:00 a.m.) interval, which fits the thought that, generally speaking, the “early bird” image may apply to seniors, children, or young youths, but seldom fits with college students.

The finding also showed that the time interval 12:00 p.m.~14:00 p.m. was

perceived as the second popular one for least creative moment (7.8% for the Arts vs. 9.8% for the Management). To a certain degree, it provides an explanation for why the early afternoon (right after lunch hour) is the most unwelcome time for classes among college students (Wang, 2004).

Interaction Effects of Discipline and Time of Day on Creativity Performance

In order to have a better understanding of the time of school day and of creativity performance, this study also investigated the role of school time intervals in creativity performance among students in the arts and management programs. Put differently, this study attempted to explore the interaction effects of discipline and time of school day on creativity performance based upon the scores of two idea generation tasks (Unusual Uses & Product Improvement) adapted from the TTCT.

Derived from the results, several items deserve further clarification.

Time of Day and Performance in the Arts Program

With regard to the effects of school time intervals on creativity performance, for the arts program, statistically significant differences were found in the fluency, originality and elaboration measures (except for flexibility) at the 0.05 level.That is, except for the measure of flexibility, time of day might be an important issue to consider for arts students when performing creativity activities (e.g., idea generation

tasks).

Second, there was a relatively high performance score during the third time interval (i.e., between 1:20 p.m. and 3:10 p.m.) among the arts program students on each of the creativity measures except for flexibility. This finding somewhat parallels certain studies that conclude that visual information containing relatively fewer semantic components and perceptual tasks is functioning better during the afternoon hours (see Folkard, 1979; Folkard & Monk, 1978). Similarly, gifted people were found to achieve more during the afternoon, due mainly to people's greater ability to process long-term memory in that time period (Morton & Kershner, 1985).

Third, an opposite delineation should be noted here with regard to the relationship between objective performance test and subjective perception of least creative time interval. Briefly, this finding seems inconsistent with the result that indicates that the time interval 12:00 p.m.~14:00 p.m. is the second most popular one reported as a least creative moment. What is the reason for this inconsistency? Is it because people intuitively feel (as reported through the self-reported survey) less creative during after-lunch sluggishness, but when it is time to perform creativity-related activities (objective task tests), arts people recover quickly during a specific time period? Beyond this, another explanation may be derived from the fact that the design of time intervals in the self-reported survey differs from that for

the creativity activities (e.g., 12:00 p.m.~2:00 p.m. vs. 1:20 p.m.~3:10 p.m.).

Time of Day and Performance in the Management Program

With regard to the effects of time of day on the creativity performance scores in the management program, no difference was found on any of the creativity measures. That is, time of day is not a significant factor to consider for management students as they conduct creativity activities.

Arts People vs. Management People

The distributions for creativity performance across school time intervals, as measured by the two TTCT activities scored for fluency, flexibility, originality, and elaboration, showed statistically significant differences between groups for fluency and originality; nevertheless, surprisingly, no difference was found in flexibility and elaboration measures.

As describer earlier, the human body has its own internal rhythms (Callan, 1997); performance and achievement on various tasks have been confirmed to follow these rhythms (e.g., Biggers, 1980; Davis, 1987). According to the findings from this study, we may claim that arts students, with higher and more up-and-down scores across school time intervals, have significantly different timing patterns from management students in terms of creativity performance in producing a large

number of ideas (fluency) and generating ideas that are not obvious, commonplace, banal, or established (originality).

More important, the results seemingly reinforce the general image of "moodiness" or "ups and downs" for arts people, in which they are believed to be relatively used to feeling excited at one moment and then shutting down immediately the next. Priito (1995) also noted the presence of over-excitabilities and intuition as some of the personality attributes of creativity.

Differences among the Measures of Creativity

Some interesting findings on the analytical process relate mainly to the characteristics of the four measures of creativity— fluency, flexibility, originality, and elaboration.

Among the four measures, the performances of fluency (reflecting the ability to produce a large number of ideas), originality (representing the ability to produce ideas that are not obvious, commonplace, banal, or established), and elaboration (representing the ability to imagine and expose detail to stimuli) were all found to be affected by school time intervals among people in the arts. Moreover, the performance scores for fluency and originality across school time intervals were also found to be significantly affected by the factor of discipline.

These findings seem to imply that the performances of fluency and originality

are more like a “state” that tends to vary by occupational status (Wallace, 1964), self-estimated motivation differences (Wallace, 1964), the study of disciplines, and time of day in this study. That is, being fluent or original in creativity performance is something that will change depending upon different statuses, such as time of day or the study of a discipline of concern in this study.

In contrast, the performance of flexibility (quantifying the ability to produce a variety of kinds of ideas, to shift from one approach to another, or to use a variety of strategies) is more like a “trait” that will not change easily by the factor of concern. In other words, being a flexible person is something that will not change much through the study of variables.

Caution should be used here, however, in regarding the seemingly inconsistent results for the measure of elaboration in this study. There is no difference in the distributions for creativity performance across time intervals between groups; nevertheless, when examined separately, significant difference exists in performance for arts people but not for management people. One possible explanation might be that the sample size for the management group is relatively small for this specific test (31 responses out of 143 study sample), rendering it not powerful enough for statistical testing, not only for the individual group testing but also for testing when the interaction effect is of concern.

In addition, the elaboration measure is not recommended by the developer of

the Torrance Tests of Creative Thinking for any further interpretations under most circumstances. The reason for the inclusion of this measure in this study is the higher expected performance for management students, since the elaboration score represents the ability to imagine and expose detail to stimuli; the result seemed to indicate otherwise. Consequently, the implications and suggestions provided below will not go into any detail about the elaboration measure.

Implications of the Study Findings

Creativity development has been gaining in popularity among educators and researchers (as mentioned earlier). Many efforts have been devoted to exploring the emotional, physical, motivational, and mental health factors that would affect creative functioning and development (Torrance, 1974). This current study was carried out to probe the relationships between time of day and creativity. Based upon the findings, it appears justified to state that timing is an important factor in creativity, and people in different disciplines may demonstrate different timing patterns in terms of creativity and its performance. The implications derived from this study add the following new insights to creativity domains with a focus on pedagogy, research, and industry and society, as detailed below.

Pedagogical Implications

Some suggestions relate to creativity education curricula, and are proposed for school administrators and creativity instructors in higher education institutions. They are made with the hope that creativity education would develop more practical curricula and implement more “creative” instructional approaches in consideration of an individual’s difference so that the younger generations and the society as a whole will benefit from them.

“Bad Student,” “Lousy Teacher,” or “Wrong Time”

First, this study found that relatively higher percentages of arts students preferred the “after midnight” time intervals for creativity activities. Meanwhile, everyone who has lectured to sleepy students knows how hard it is to teach the “night owl” learning-style student under the current school scheduling system; anyone who has been through a “dead” class knows what is meant here. When you, as a class instructor, think to blame yourself as a lousy teacher, or try to ascribe the problem to your students being passive learners, hold that thought for a moment. After scrutinizing all of the possible factors in class failure, it might occur to you that simply “offering the class at the wrong time” might be the very reason for its sluggishness.

Moreover, poor creativity performance of arts students during the morning

hours might be due to their inherited habit of staying up late. Therefore, “timing” should be one important issue to take into account when creativity instructors try to assess the success or failure of their instruction.

A State or a Trait

Behaviorists believe that everything can be changed, including mood and intelligence. Some psychoanalysts even argue that all personality traits can be worked through with enough wisdom. In contrast, biologists tell us that nothing basic can be changed. Our personality traits are fixed through inherited genes. Seligman (1995) claimed that these themes are all ideological falsehoods and believed that some things could change while some biological boundaries could not be “worked through.”

The results from this study show that the arts people’s performance in fluency, originality and elaboration (except for flexibility) are affected by different time of day intervals but that there is no significant difference in any of the four measures of creativity for the management people. These findings indicate at least two things: First, the performance of creativity is characterized by stability among management people. In contrast, for the arts people, the performance of creativity is recognized as a characteristic of a “state”, which will change according to timing factors. Second, among the four measures of creativity, flexibility has the highest level of stability

with regard to the timing factor.

In other words, if a parent was surprised by his/her child's fluency in creatively performing many original and creative ideas while building with Lego blocks one evening and urged him/her to show off to the neighbors the next morning, the parent may probably need to prepare for the possible disappointment resulting from the timing factor. That is, if you love your child's or students' creativity, please extend your love to the occasional "state" characteristics of fluency and originality for creative people and be aware of the "ups and downs" of performance that occur with time of day.

On the other hand, flexibility in this study is a relatively more stable cognitive trait within each individual person, while the trait differs from person to person. That is, whether or not one is a flexible person may be something that will not change much along one's time span. Realizing what we may change and what we cannot change easily is the first step in learning to accept who you are and knowing about that there are constraints placed by evolution on learning (Seligman, 1995).

School Scheduling Change or Student Routine Behavior Change

In the domains of time scheduling and learning style, more and more educators and researchers have begun to recognize the importance of school scheduling. They have come to realize that by uniformly scheduling the school day without

considering individuals' or groups' differences, students may never be able to achieve their maximum performance.

Similarly, in the creativity domain, researchers also claim that creators usually prepare and incubate for a while, and then just wait for the "aha experience" (the inspiration stage for ideas to jump out from the jungle thoughts) during creative processes. Therefore, "right on my time or not" seems to have always been a critical issue for creators with regard to incubation and inspiration activities.

In summary, the findings from this study lead us to ask, "Do we need to consider seriously a different school scheduling system, particularly for people in the arts, or continue to exert our attempt to change students' routine behavior?" In one way or another, an open mind and awareness of program differences are helpful to creativity educators as they deal with teaching and learning across disciplines. Of course, further research regarding these issues is expected.

Research Implications

First, a large body of research on creativity in educational settings argues that a supportive and meaningful environment can be helpful in fostering creative potentials (Coleman & Colbert, 2001; Souza Fleith, 2000). In addition, Krathwohl (1997) argued, "Clearly,… some pattern is better for each of us, and we must find it" (p. 94) and encouraged people to find their own most productive conditions with

regard to when and where to work. Oldach (1995) also stressed the importance of one's own awareness of the most productive time for creative activities. However, as described earlier, few studies focus on the investigation of the most productive moment of creativity. So far, no one has explored the effects of time of day on creativity performance. A better understanding of this issue would provide educators and learners, particularly those in the art and design fields, a clue for better scheduling of learning in creativity.

The findings from this study provide a first step in looking at the relationship between time of day and creativity performance. It is also expected that educational administrators and instructors will give closer attention to the fact that time of day does have influence on creativity performance in terms of fluency and originality, particularly for arts people. The findings suggest an avenue through which to link timing, an important factor for creators, with creativity in further research related to the field of creativity education.

Industry and Societies

In most "creativity-highly-related" companies, such as art, photography, advertising, design, etc., there are either more flexible working hours or late day working schedules specifically tailored for those artists, photographers, and designers in certain departments. Moreover, for those creative freelancers who work

stand-alone, it is not unusual to hear that they easily and spontaneously fall into a reverse life style and come to realize that “the more deeply the night, the more creatively alive.”

However, problems arise when differences occur within our regulated human systems. Those “art creeps” who don’t have much “day” life and follow their personality traits quite often lose contact with people in “normal” society. Therefore, it is important for a company to tolerate those people who are different; to be aware of the possible biological boundaries in creativity; and to keep the door wide open for creative activity.

Thus, when people in a company or an industry say that they want creative thinkers, they need to really prepare for them. Creativity means more troubles later. We stifle and discourage creativity without self-awareness, because creativity always violates rules and principles (Farson, 1997). The lack of a supportive environment often causes creativity to dry out under certain “has-to-be” conditions. And, the social pressure from the society we create so far proves what is said—"Progress is made only by those who are strong enough to endure being laughed at.”

In the belief that creativity is an important factor constantly reshaping the world in which we live and with the belief in its importance in schools (Starko, 2000), we should be cautious about what we are going to create for the next generation. With a hope that the uncertainty of creativity nature could be tangibly recognized and

tolerated so that our next generations and future society will benefit, this study showed that time of day should be a factor to consider in creativity, particularly among arts people, and the discipline differences in timing patterns for creativity should also be respected in our society and industry.

Limitations of This Study

Although all research questions in this study were satisfactorily answered, the anticipated contributions to knowledge about creativity and its timing are limited in several ways.

Generalizability Issue

First and most important, this study uses for analysis only the sample subjects selected solely from two programs (Computer-aided Media Design and Health Care Administration) at one university. With the intention of making comparisons between the two broader fields of people (arts vs. management), this study might encounter critical challenges in the generalizability of empirical results. In other words, more representative samples are needed to infer more convincing implications from this study.

Second, theoretically, the research design can also be improved by a more appropriate sampling procedure, with the questionnaire survey conducted prior to

the implementation of TTCT tasks to ensure the representativeness of the study sample for each program. As described in chapter 3, due to the time constraints of classes, it was truly difficult (if not impossible) to request more frequent access than was allowed in this study to reach students. Therefore, an alternative was to conduct the survey questionnaire and the creativity task at the same time. Consequently, it turned out that the study sample retained for final analyses was somewhat different from that targeted from the beginning, which not only raises concerns about selection bias but also involves issues of no-preference and non-response bias and missing values. In recognition of the trade-offs, nevertheless, this study took no steps to take into account the effect of the biases, but rather acknowledged caution about its generalizability.

Measurement Issue

First, it is not uncommon to use part of the activities from the Torrance Tests of Creative Thinking to conduct creativity-related research (e.g., Fleming & Weintraub, 1962; Lieberman, 1965; Torrance, 1963; Weisberg & Springer, 1961). The developer of TTCT (Torrance Tests of Creative Thinking) even stated in the manual and scoring guide that "…no effort was made to select activities that would be highly correlated with one another" (Torrance, 1974, Verbal Form A, p. 10). However, there are still certain psychological rationales that the author sketched separately for each

activity or test task contained in the TTCT. What remains unknown is whether this lack of differentiation for each activity could result in any misinterpretation in this study.

Second, the reliability and validity of self-reported responses to the questions of creativity timing and creativity-conducting frequency are undoubtedly less than perfect. To the extent that it is difficult to judge them consistently and accurately, errors would be added to the results of analyses.

Third, while the developer of TTCT claimed that "…the intercorrelations have been rather consistently above .90 and there have been only very small differences in means" (Torrance, 1974, Verbal Form A, p. 17), which indicates that inter-rater reliability would not be a concern, in this study, the inter-rater reliability was still tested to assure the reliability of scoring in advance before conducting the comprehensive scoring tasks afterwards. Even so, nevertheless, there is still imperfection in scoring since only one scorer took the full responsibility in this study. In other words, due to the fact that it is undeniably energy-exhausting and time-consuming to score all idea responses one by one for each activity for a total of 295 participants, the one-scorer strategy used in this study would probably account for some errors and problems.

Suggestions for Future Studies

In recognition of the limitations that characterize the sampling method and measurement issues, a few suggestions are proposed for future studies.

The self-evaluation of creative timing based on students' self-cognition of creativity is undoubtedly less than perfect in this study. Research designs other than those using the self-reporting method in studying creativity timing and relevant issues need further exploration, although research has confirmed that most college students can actually predict modality in which they demonstrate superior learning performance (e.g., Domino, 1970; Far, 1971). A more objective measurement is necessary to study the around-the-clock timing of creativity. In addition, a qualitative research approach to documenting and recording timing patterns with the aid of information technology might be applied as well.

Furthermore, instead of exclusively paralleling the assigned two-hour time intervals along with school day time schedules, it might be better to include evening class time periods (usually from 6:30 p.m. to 10:30 p.m.) in the schedule, since the most creative time interval for both programs' students, according to the self-reported survey, was during evening after 8:00pm. It will be interesting to see how students perform during their favorite time interval for creativity.

Conclusion

First, this study validates the undeniable role of time pattern on creativity education. In higher education, creativity development has triggered investigations of factors that might influence its success or failure. This study shows that the influence of timing, particularly for Arts people, cannot be overemphasized. Therefore, it is necessary to keep exploring this promising area of research in the hope of continuing the improvement of the creativity learning environment and instruction.

As Thoreau (1854/1957) declares, “To affect the quality of the day, that is the highest of arts” (p. 62). Confronted with the high challenge of providing the most effective, engaging activities for learning, educational institutions need to realize that time-of-day arrangements must be efficiently allocated and carefully designed in new, different, and better ways (Peyton, 1995). Further, the learner profiles and individual differences need to be identified and included in instructional goals. Only then can the work of constructing a meaningful and helpful timetable proceed. And only then can the art of “affecting the quality of the day” be implemented. After all, undeniably, next to people, time is the most valuable resource in school and it is nonrenewable (Callison, 1998).

Finally, in the hope of creating a free learning environment that respects creators’ individual differences in our next generation and future society, the

findings from this study may shed light on the path toward the not-so-distant utopia, in which individual differences are noticed and respected.

References

Adan, A. (1991). Influences of morningness-eveningness preference in the relationship between body temperature and performance: A diurnal study. *Personality and Individual Differences*, *12*, 1159-1169.

Amabile, T.M., Dejong, W., & Lepper, M.R. (1976). Effects of externally imposed deadlines on subsequent intrinsic motivation. *Journal of Personality and Social Psychology*, *34*, 92-98.

Arieti, S. (1976). *Creativity: The magic synthesis*. New York: Basic Books.

Astin, A.W. (1993). *What matters in college? Four critical years revisited.* San Francisco, CA: Jossey-Bass.

Beattie, D.K. (2000). Creativity in art: The feasibility of assessing current conceptions in the school context. *Assessment in Education, 7*, 175-192.

Biggers, J. L. (1980). Body rhythms, the school day, and academic achievement. *Journal of Experimental Education*, *49(1)*:45-47.

Blake, M.J.F. (1971). Temperament and time of day. In W.P. Colquhum (Ed.), *Biological rhythms and human performance*. New York, NY: Academic Press.

Borland, J.H. (1988). Cognitive controls, cognitive styles, and divergent production in gifted preadotesoents. *Journal for the Education of the Gifted, 2*, 57-82.

Callan, R. J. (1997). Giving students the (right) time of day. *Educational Leadership.*

55, 84-87.

Chase, C.I. (1985). Review of the Torrrance Tests of Creative Thinking. In O.K. Buros (Ed.), *The ninth mental measurements yearbook* (pp. 1631-1632). Lincoln, NE: Buros Institute of Mental Measurements.

Clapham, M.M. (1998). Structure of figural forms A and B of the Torrance Test of Creative Thinking. *Educational and Psychological Measurement, 58*, 275-283.

Cole, D.G., Sugioka, H.L., & Yamagata-Lynch, L.C. (1999). Supportive classroom environments for creativity in higher education. *Journal of Creative Behavior, 33*, 277-293.

Coleman, R., & Colbert, J. (2001). Grounding the teaching of design in creativity. *Journalism & Mass Communication Educator, 56*, 4-24.

Crockenberg, S. (1972). Creativity tests: Boon or boondoggle for education. *Review of Educational. Research*, *42*, 27-46.

Cropley, A.J. (2000). Defining and measuring creativity: Are creativity tests worth using? *Roeper Review*, *23*, 72-79.

Csikszentmihalyi, M., Rathunde, K., & Whalen, S. (1993). *Talented teenagers: The roots of success and failure.* New York: Cambridge University.

Csikszentmihalyi, M. (1995). *Creativity*. New York: HarperCollins.

Dallob, P.I., & Dominowski, R.L. (1992). *Erroneous solutions to verbal insight problems: Fixation or insufficient monitoring?* Paper presented at the meetings

of the Western Psychological Association. Portland. OR.

Davis, G.A. (1989). Testing for creative potential. *Contemporary Educational Psychology, 14*, 257-274.

Davis, Z. T. (1987). Effects of time-of-day of instruction of beginning reading achievement. *Journal of Educational Research, 80(3)*, 138-140.

Domino, G. (1970). Interactive effects of achievement orientation and teaching style on academic achievement. *ACT Research Report. 39*, 1-9.

Dunn, R. (1998). Timing is everything. *Momentum*, (Oct./Nov.), 23-25.

Dunn, R. & K. Dunn. (1993). *Teaching secondary students through their individual learning styles: Practical approaches for grades 7-12*. Boston: Allyn and Bacon.

Dunn, R., Dunn, K., Primavera, L., Sinatra, R., & Virostko, J. (1987). A timely solution: A review of research on the effects of chronobiology on children's achievement and behavior. *The Clearing House*, *61*, 5-8.

Eysenck, M. W. (1982). *Attention and arousal: Cognition and performance.* Berlin: Springer Verlag.

Farr, B. J. (1971). *Individual differences in learning: Predicting one's more effective learning modality*. Ph.D. dissertation. Catholic University of America.

Finke, R.A., Ward, T.B., & Smith, S.M. (1992). *Creative cognition: Theory, research, and applications*. Cambridge, MA: MIT Press.

Fishkin, A. S. (1999). Issues in studying creativity in youth. In A. S. Fishkin, B. Cramond,, & P. Olszewski-Kubilius (Eds.), *Investigating creativity in youth. Cresskill,* NJ: Hampton Press, Inc.

Folkard, S. & Monk, T. H. (1979). Time of day processing strategy in free recall. *The Quarterly Journal of Experimental Psychology, 31,* 461-475.

Folkard, S. (1979). Time of day and level of processing. *Memory and Cognition, 7,* 247-252.

Gallagher, J.J. (1975). *Teaching the gifted child* (2nd ed.). Boston: Allyn and Bacon.

Gate, A.I. (1916). Diurnal variation in memory and association. *Publications in Psychology, 1,* 323-344.

Gow, G. (2000). Understanding and teaching creativity. *Tech Directions, 59,* 32.

Guildford, J.P. (1967). *The nature of human intelligence.* New York: McGraw-Hill.

Hackman, D.G., & Schmitt, D.M. (1997). Strategies for teaching in a block-of-time schedule. *National Association of Secondary School Principals. NASSP Bulletin, 81,* 1-9.

Heausler, N.L., & Thompson, B. (1988). Structure of the Torrance Tests of Creative Thinking. *Educational and Psychological Measurement, 48,* 463-468.

Hickey, M. (2001). An application of Amabile's consensual assessment technique for rating the creativity of children's musical compositions. *Journal of Research in Music Education, 49,* 234-244.

Hocevar, D. (1981). Measurement of creativity: Review and critique. *Journal of Personality Assessment, 45,* 450-464.

Hockey, G. R. J., Davies, S. & Gray, M. M. (1972). Forgetting as a function of sleep at different times of day. *The Quarterly Journal of Experimental Psychology. 24*,386-393.

Horne, J.A. & Östberg, O. (1977). Individual differences in human circadian rhythms. *Biological Psychology, 5*, 179-190.

Houtz, J., & Krug, D. (1995). Assessment of creativity: resolving a mid-life crisis. *Educational Psychology Review*, *7*, 269-330.

Isaksen, S.G., Panes, S.J. (1985). Curriculum planning for creative thinking and problem solving. *Journal of Creative Behavior*, *19*, 1-29.

Ishihara, K., Honma, Y. & Miyake, S. (1990). Investigation of the children's version of the morningness-eveningness questionnaire with primary and junior high school pupils in Japan. *Perceptual and Motor Skills, 71,* 1353-1354.

Javierre, C., Ventura, J.L., Segura, R., Calvo, M., & Garrido, E. (1996). Is the post-lunch dip in sprinting performance associated with the timing of food ingestion? *Journal of Physiology and Biochemistry*, *52,* 247-253.

Johns, G.A., & Morse, L.W. (1997). Divergent thinking as a function of time and prompting to "be creative" in undergraduates. *Journal of Creative Behavior, 31,* 156-165.

Johns, G.A., Morse, L.W., & Morse, D.T. (2001). An analysis of early vs. later responses on a divergent production task across three time press conditions. *Journal of Creative Behavior*, *35*, 65-72.

Jung, C.G. (1961). *Memories, dreams, reflections*. New York: Pantheon.

Kawenski, M. (1991). Encouraging creativity in design. *Journal of Creative Behavior*, *25(3)*, 263-266.

Kellogg, R. T. (1986). Writing method and productivity of science and engineering faculty. *Research in Higher Education, 25*, 147-163.

Kirschenbaum, R.J. (1998). The creativity classification system: An assessment theory. *Roeper Review*, *21*, 20.

Klavas, A. (1994). In Greensboro, North Carolina: Learning style program boosts achievement and test scores. *The Clearing House. 67(3),* 149-151.

Krathwohl, D. R. (1997). *Methods of educational and social research* (2nd ed.). Reading: Addison-Wesley.

Kwon, M., Goetz, E.T., & Zellner, R.D. (1998). Research note: Developing a computer-based TTCT: Promises and problems. *Journal of Creative Behavior*, *32*, 96-107.

La Greca, A. M. (1980). Can children remember to be creative? An interview study of children's thinking processes. *Child Development, 51,* 572-575.

Lemmon, P. (1985). A school where learning style make a difference. *Principal*

64(4), 26-29.

Maltzman, I. (1960). On the training of originality. *Psychological Review, 67,* 229-242.

Maslow, A. (1968). *Toward a psychology of being*. New York: Van Nostrand.

Mayo Clinic. (1995). Circadian rhythms: These 24-hour cycles keep you on schedule. *Mayo Clinic Health Letter 13,* 3. Rochester, MN.: Mayo Foundation for Medical Education and Research.

Merrifield, P.R., Guilford, J.P., Christensen, P.R., & Frick, J.W. (1962). The role of intellectual factors in problem solving. *Psychological Monographs, 76,* 21.

Millar, K., Styles, B.C., & Wastell, D.G.. (1980). Time of day and retrieval from long-term memory. *British Journal of Psychology, 71*, 407-414.

Mohan, M. (1971). *Interaction of physical environment with creativity and intelligence*. Unpublished doctoral dissertation, University of Alberta, Edmonton, Canada. Quoted in Torrance, E.P. (1988), The nature of creativity as manifest in its testing. In R.J. Sternberg (Ed.), *The nature of creativity: Contemporary psychological perspectives.* (pp. 43-75). Cambridge: Cambridge University Press.

Morganett, L. (1991). Good teacher-student relationships: A key element in classroom motivation and management. *Education, 112*, 260-264.

Morton, L.L., & Kershner, J.R. (1993). Time of day and attentional-order influences

on dichotic processing of digits in learning-disabled and normal-achieving children. *Journal of Neuroscience, 71*, 51-61.

Morton, L.L., & Kershner, J.R. (1993). Time of day effects upon children's memory and analogical reasoning. *The Alberta Journal of Educational Research, 31*, 26-34.

Munford, M.D. (1998). Creative thought: Structure, components, and educational implications. *Roeper Review*, *21*, 14.

Natale, V. & Cicogna, P. (1996). Circadian regulation of subjective alertness in morning and evening types. *Personality and Individual Differences, 20*, 491-497.

Natale, V. & Lorenzetti, R. (1997). Influences of morningness-eveningness and time of day on narrative comprehension. *Personality and Individual Differences, 23*, 4, 685-690.

National Education Commission on Time and Learning. (1994). *Prisoners of time*. Washington, DC: U.S. Department of Education.

Oldach, M. (1995). *Creativity for graphic designers.* Cincinnati, OH: North Light Books.

Olson, M.B. (1977). Right or left hemispheric information processing in gifted students. *Gifted Child Quarterly, 21*, 116-121.

Osborn, A.F. (1963). *Applied imagination* (3rd ed.). New York: Scribner.

Parnes, S.J. (1967). *Creative behavior guidebook.* New York: Scribner.

Piirto, J. (1998). *Understanding those who create*. (2nd ed.) Scottsdale, AZ: Gifted Psychology Press.

Piirto, J. (1999a). Synchronicity. In *Encyclopedia of Creativity*. Ashland, OH: Ashland University Academic Press. Retrieved September 20, 2003, from http://www.ashland.edu/~jpiirto/synchronicity.htm.

Piirto, J. (1999b). Implications of postmodern curriculum theory for the education of the talented. *Journal for the Education of the Gifted, 22(4)*, 324-353.

Piirto, J. (1999c). A different approach to creativity enhancement. *Tempo, 19(3),* 1.

Piirto, J. (1999d). A survey of psychological studies in creativity. In A. S. Fishkin, B. Cramond,, & P. Olszewski-Kubilius (Eds.), *Investigating creativity in youth. Cresskill*, NJ: Hampton Press, Inc.

Rhodes, M. (1961). An analysis of creativity. *Phi Delta Kappan*, *42*, 305-310.

Saeki, M., Fan, X., & Dusen, L.V. (2001). A comparative study of creative thinking of American and Japanese college students. *Journal of Creative Behavior, 35*, 24-36.

Sajjadi-Bathgi, H. (1984). Effects of time press and imagery control on creativity in the production of verbal originality and creative analogies. *Dissertation Abstracts International.*

Schroth, G. (1997). *Fundamentals of school scheduling*. Lancaster, PA: Technomic.

Seligman, E.P. (1995). *What you can change and what you can't.* New York: Fawcett Columbine.

Shallcross, D.J. (1981). *Teaching creative behavior: How to teach creativity to children of all ages.* Englewood Cliffs, NJ: Prentice Hall, Inc.

Shaughnessy, M. F. (1991). *The supportive educational environment for creativity*. (ERIC Document Reproduction Service NO. ED 360 080).

Shaughnessy, M.F. (1998). An interview with E. Paul Torrance: About creativity. *Educational Psychology Review*, *10*, 441-452.

Sheldrake, R. (1994). *The rebirth of nature: The greening of science and God*. Rochester, VT: Park Street Press.

Souza Fleith, D. (2000). Teacher and student perceptions of creativity in the classroom environment. *Roeper Review*, *22*, 148.

Sternberg, R.J. (2000). Identifying and developing creative giftedness. *Roeper Review*, *23*, 60-64.

Sternberg, R.J., & Lubart, T. 1. (1991). An investment theory of creativity and its implications for development. *Human Development*, *34*, 1-31.

Stranger, R. H. (2004). *A study of high school schedules and standardized testing performance*. Doctoral dissertation, University of California Riverside.

Tang, X.M. (1987). *A study on schedule-arranging automation for military colleges*. Taipei, Taiwan: Institute of Resources Management, National Defense College.

Thayer, R.E. (1967). Measurement of activation through self-report. *Psychological Reports, 20*, 663-678.

Thoreau, H.D. (1854/1957). *Walden*. Ed S. Paul. Boston: Houghton Mifflin.

Torrance, E.P. (1962). *Guiding creative talent*. Englewood Cliffs, NJ: Prentice-Hall.

Torrance, E.P. (1966). *Torrance Tests of Creative Thinking*. Bensenville, IL: Scholastic Testing Service.

Torrance, E.P. (1974). *Torrance Tests of Creative Thinking: Directions manual and scoring guide (Verbal Test, Form A)*. Princeton, NJ: Personnel Press, Inc.

Torrance, E.P. (1981). *Thinking creativity in action and movement*. Bensenville, IL: Scholastic Testing Service.

Torrance, E.P. (1990). *Torrance Tests of Creative Thinking: Norms and technical manual*. Bensenville, IL: Scholastic Testing Service.

Torrance, E.P. (1999). *Torrance Tests of Creative Thinking: Norms and technical manual*. Bensenville, IL: Scholastic Testing Service.

Treffinger, D. (1997). Why fly? A philosophy of creativity. *The Gifted Child Quarterly, 41*, 54-55.

Treffinger, D.J. (1985). Review of Torrance Tests of Creative Thinking. *Ninth Mental Measurements Yearbook* (pp. 1632-1634). Lincoin, NE: University of Nebraska Press.

Wallas, G. (1926). *The arts of thought*. London: Jonathan Cape.

Wang J.S. (2004). *A study on schedule-arranging optimization using multiple objective programming model.* [in Chinese]. Master's thesis, National Cheng Kung University.

Wiles, J., & Bondi, J. (1981). *Skills clusters for creative thinking activity book*. Tampa: Wiles, Bondi and Associates.

Appendix A: Self-reported Questionnaire

Age: _____

Gender: ☐ Male ☐ Female

Level: ☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior

Major: ☐ Arts ☐ Management

Date: ____ / ____ / ____ (month / day / year)

In terms of your definition of creativity----

1. What times of the day do you find yourself most creative? (Please make one choice)

☐ 6:00~8:00 AM ☐ 8:00~10:00 AM ☐ 10:00 AM~12:00 PM ☐ 12:00~2:00 PM

☐ 2:00~4:00 PM ☐ 4:00~6:00 PM ☐ 6:00~8:00 PM ☐ 8:00~10:00 PM

☐ 10:00~12:00 PM ☐ 12:00~2:00 AM ☐ 2:00~4:00 AM ☐ 4:00~6:00 AM ☐ Don't know

2. What times of the day do you find yourself least creative? (Please make one choice)

☐ 6:00~8:00 AM ☐ 8:00~10:00 AM ☐ 10:00 AM~12:00 PM ☐ 12:00~2:00 PM

☐ 2:00~4:00 PM ☐ 4:00~6:00 PM ☐ 6:00~8:00 PM ☐ 8:00~10:00 PM

☐ 10:00~12:00 PM ☐ 12:00~2:00 AM ☐ 2:00~4:00 AM ☐ 4:00~6:00 AM ☐ Don't know

3. How often do you think you deal with so-called creative tasks averagely?

☐ Very often ☐ Often ☐ Average ☐ Sometimes ☐ Seldom ☐ Never

4. Do you think that art (or Management) is the appropriate field for you to study in?

☐ Yes
☐ No If no, what other field is appropriate? _____

Appendix B: Creative Idea Generation Tasks (English Version)

Name:_____

Dept.:_____ Level:_____

Activity 1: Unusual Uses (cardboard boxes)

Most people throw their empty cardboard boxes away, but they have thousands of interesting and unusual uses. In the spaces below, list as many of these interesting and unusual uses as you can think of. Do not limit yourself to any one size of box. You may use as many boxes as you like. Do not limit yourself to the uses you have seen or heard about; think about as many possible new uses as you can.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8.

9.

10.

11.

12.

13.

14.

15.

16.

17.

18.

19.

20.

21.

22.

23. _____

24. _____

25. _____

26. _____

27. _____

28. _____

29. _____

30. _____

31. _____

32. _____

33. _____

34. _____

35. _____

36. _____

37. _____

38. _____

39. _____

40. _____

41. _____

42. _____

43. _____

44. _____

45. _____

46. _____

47. _____

48. _____

49. _____

50. _____

Activity 2: Product Improvement

In the middle of this page is a sketch of a monkey of the kind you can buy in most dime stores for about one to two dollars. It is about six inches tall and weighs about six ounces. In the spaces on this page and the next one, list the cleverest, most interesting and unusual ways you can think of for changing this toy monkey so that children will have more fun playing with it. Do not worry about how much the change would cost. Think only about what would make it more fun to play with as a toy.

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

13. _____

14. _____

15. _____

16. _____

17. _____

18. _____

19. _____

20. _____

21. _____

22. _____

23. _____

24. _____

25. _____

26. _____

27. _____

28. _____

29. _____

30. _____

31. _____

32. _____

33. _____

34. _____

35. _____

36. _____

37. _____

38. _____

39. _____

40. _____

41. _____

42. _____

43. _____

44. _____

45. _____

46. _____

47. _____

48. _____

49. _____

50. _____

Adapted from—Torrance, E.P. (1974). *Torrance Tests of Creative Thinking: Directions Manual and Scoring Guide (Verbal Test, Form A&B)*, Princeton, N.J.: Personnel Press, Inc.

Creative Idea Generation Tasks (Chinese Version)

姓名:_____

系別:_____ **年級:**_____

活動一：不尋常的利用 （紙箱篇）

大部分的人會將不用的空紙箱丟棄，然而，這些廢棄紙箱其實可以有許多有趣且不尋常的用處。請於下列空白處，盡可能列出所有你想到的有趣且不尋常的利用點子。假想有無數個紙箱可供你使用，不要限制你自己於單一大小的紙箱。也請不要限制你自己於那些已見過或聽過的點子，盡你的可能想想新的利用方式。

1. _____

2. _____

3. _____

4. _____

5. _____

6. _____

7. _____

8. _____

9. _____

10. _____

11. _____

12. _____

13. _____

14. _____

15. _____

16. _____

17. _____

18. _____

19. _____

20. _____

21. _____

22. _____

23.

24.

25.

26.

27.

28.

29.

30.

31.

32.

33.

34.

35.

36.

37.

38. _____

39. _____

40. _____

41. _____

42. _____

43. _____

44. _____

45. _____

46. _____

47. _____

48. _____

49. _____

50. _____

Adapted from—Torrance, E.P. (1974). *Torrance Tests of Creative Thinking: Directions Manual and Scoring Guide (Verbal Test, Form A&B)*, Princeton, N.J.: Personnel Press, Inc.

Vita

Sy-Chyi Wang

Sy-Chyi Wang was born on March 20, 1969, in Kaohsiung City, south of Taiwan (historically known as Formosa—“a beautiful island”), and is a Taiwanese citizen. She graduated from Chung-Yuan Christian University, Chung-Li, Taiwan, with a B.B. in Commercial Design in 1991. After a few years as a designer in Taiwan, she attended Virginia Commonwealth University, Richmond, Virginia, and received her M.F.A. from the School of Fine Arts in 1996. While pursuing her master’s degree, she worked as an adjunct instructor for the Department of Communication Arts and Design at VCU, and as a part-time designer for the School of Business there. After a few years in the design industry as an art director in Taiwan, she began her teaching career as a full-time instructor in the Department of Computer-aided Media Design at Chang Jung University, Tainan County, Taiwan. While pursuing her doctoral degree in Instructional Systems at Penn State University, State College, Pennsylvania, she was on “leave” from her teaching position.