THE EFFECTS OF MUSIC ON CREATIVITY

IN THE DESIGN PROCSS

By

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Abstract

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From the perspective of cognitive psychology, the design process is driven by creative cognition. The organization of cognitive material is influenced by a number of environmental elements, including music. The aim of this study is to examine the hypothesis that music has an indirect effect on creativity in the design process. An experiment was designed to observe different levels of creativity in the final product of the design process. The study consisted of two phases. In both phases the participants were students of Interior Design, enrolled in the final year of their programs.

A pilot experiment was carried out in the first phase for the purpose of examining theoretical assumptions and adequacy of the experiment's design. The main experiment was conducted in the second phase. It was designed to have two sessions. In both sessions the participants were asked to solve a creative design task. By the end of the two sessions all participant had worked with and without music stimuli. Final design solutions from both sessions were then assessed using the Consensual Assessment Technique, a standard method for assessing creative products. The Consensual Assessment Technique was conducted in order to determine if there were differences in levels of creativity in the final design products.

The paired-samples *t* test offered evidence that the hypothesis of the relationship between music stimuli and creativity in the design process is inconclusive. While the test results showed that the designs done without music stimuli scored lower and the designs done under music stimuli scored higher, this difference was not statistically significant. Noting the study's limitations, it is appropriate to note the direction of the means which supports further research using more appropriate methods. The intent of this study was to indicate a possible relationship between music listening and the design process, and to stimulate an awareness for the role that creative cognition plays in the design process and how it reflects in the quality of the final design product.

TABLE OF CONTENTS

Page

ACKNOWLEDGMENT iii

ABSTRACT iv

LIST OF TABLES ix

LIST OF FIGURES x

CHAPTER

INTRODUCTION 1

Design process and creative cognition 1

Emotional states of being and music listening 2

Hypothesis 3

REVIEW OF LITERATURE 5

Design process as cognitive process 5

Creative cognition: Discussion of theoretical context 6

Creativity and creative assessment technique 9

Drawings as artifacts of creative cognition 12

Emotions Influence Creative Cognition 13

Music and its effect 15

Summary 16

RESEARCH DESIGN AND METHOD 17

Pilot experiment – testing method 17

Main experiment description 18

The design task 19

The experiment procedure 22

Analysis: Consensual Assessment Technique 25

Analysis: Interjudge reliability 27

FINDINGS 28

Findings: Interjudge reliability 29

Findings: Consensual Assessment Technique 30

Discussion on Findings 37

LIMITATIONS 41

Experiment Design and Method Limitations 41

Consensual Assessment Technique Limitations 44

CONCLUSION 46

BIBLIOGRAPHY 47

APPENDIX 52

A. Study Student Design Assignment 52

B. Cover letter to judges using Consensual Assessment Technique (CAT) 54

C. Rating sheet used for Consensual Assessment Technique 55

D. Examples of the design solutions created by students (D4&D5) 56

E. Examples of the design solutions created by students (D8&D13) 57

F. Examples of the design solutions created by students (D14&D17) 58

LIST OF TABLES

1. Interjudge reliability statistics (Cronbach's alphas)……30

2. The medians of design products done with music stimuli across all dimensions……...31

3. The median scores of design products done without music stimuli across all dimensions….32

4. The median scores in creativity dimension ...…….....33

LIST OF FIGURES

1. Structure of the study. 4

2. Basic structure of the Geneplore model. 7

3. The experiment. Image 1 – first session. Image 2 – second session. 19

4. The experiment setting. 23

5. Seating organization of the participants in the first session. 24

6. Outlay for exhibiting designs. 25

7. Results of the paired-samples t test. 34

8. Median scores for 34 design solutions. 35

9. Median scores of creativity for designs in the first session. 36

10. Median scores of creativity for designs in the second session. 36

CHAPTER ONE

INTRODUCTION

Design process and creative cognition

The design process is seen as a composite of creative cognitive activities. Protocol studies on design and psychology provide verification for the claim stated above (Akin & Lin, 1995; Gero & Mc Neil, 1998; Purcell & Gero, 1998; Bilda & Demirkan, 2003; Goldschmidt & Smolkov, 2006; Suwa, Purcell & Gero, 2006; Coley, Houseman & Roy, 2007). According to these studies, the design process involves a variety of cognitive activities that enable the designer to rationalize problems and discover ways of solving them. Various cognitive activities employed in the design process drive creative thinking.

The creative cognition approach developed by Finke, Ward and Smith (1996) is accepted in the research community (e.g. Purcell & Gero, 2006; Goldschmidt & Smolkov, 2006). The authors of creative cognition developed the "general theory of creativity" a model that relates cognitive processes and resulting creative products. This model of creative cognition is called the Geneplore Model which provides an understanding of how creativity is expressed in a design. The Geneplore Model identifies two phases in the creative cognitive process: generative and exploratory. In the generative phase a person constructs preinventive structures with properties based on mental images. These properties are then further examined in the exploratory phase where a person seeks to find meaningful internal solutions that eventually inform an externalized creative product. According to the Geneplore Model the creative cognitive process starts when a cycling between the two phases begins, and it lasts until a person finds a satisfactory solution.

Thus when a designer engages in creative thinking it can be recognized as the cycling between the generative and explorative phase. The outcome of the creative cognitive process is a product.

In this study a creative product will be regarded as an artifact of the cognitive processes. This study looks more closely into proposition drawings, the type designated by Lawson (2004). This is the point in the design process where a designer externalizes through drawings some features of the design situation in order to examine them in a more focused way. The proposition drawings encapsulate proposed solution. In this study the proposition drawings emerge in the preliminary design phase, and through further analysis are regarded as a data source.

Emotional states of being and music listening

Research supports that the emotional state of being influence performance on cognitive tasks. Isen, Daubman and Nowicki (1987) examined the effects of positive mood on creative problem solving. Participants who were exposed to a few minutes of a comedy film showed improved performance when compared to those who were exposed to a sad movie. The authors concluded that a person's state of being indeed had an effect on creative performance. This finding is supported through research in the field of neuropsychology (Ashby, Isen and Turken, 1999). The study results suggest that many positive feelings are associated with increased brain dopamine levels. According to the authors of the neuropsychological theory assumes that creative problem solving is improved, in part, because increased dopamine releases in the anterior cingulate which improves cognitive flexibility and facilitates cognitive perception.

Past studies suggest that music emotionally influences those who listen to it (e.g. Lesiuk, 2005). The state of being following music listening is in relation to a person's unique past experiences. Influenced by music, individuals' state of being is the result of their projecting their

past tonal-rhythmic experiences. Stratton and Zalanowski (1984) examining a comparison of five different music types and reported a significant correlation between degree of relaxation and preference for music. Lesiuk (2005) explored the influence of music on levels of creativity in performance. She reported that the state anxiety level decreased when music was used prior to and throughout a creative task, and that state of being, positive feelings, and quality of work was lowest with no music.

Hypothesis

Creative cognitive activities have been investigated in relation to the design process. However, a question that has not yet been addressed is whether music listening during the design process has any impact on levels of creativity of the final design product - drawings. Information found in literature points to the existence of a relationship exists. These findings require further examination to determine whether or not this relationship is evident in the final design product. Therefore, the hypothesis is that music has an indirect effect on creativity in the design process. In order to examine this hypothesis the study observes different levels of creativity in the final design products. For the purpose of this study presentational drawings created by a group of students will be regarded as a final design product. The structure of the study is presented in the Figure 1.

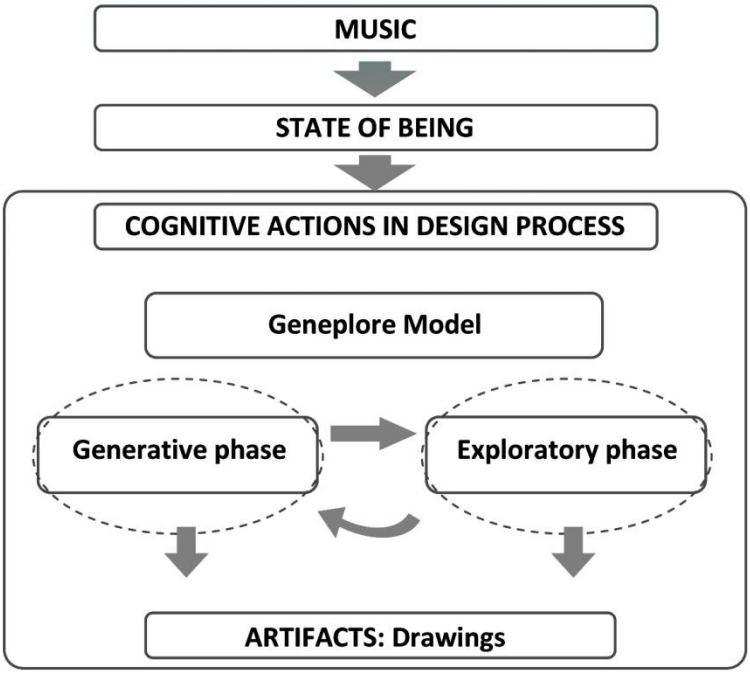


Figure 1. Structure of the study.

The relationship of music listening and the design process has yet to be examined in design research. The intent of this study is to contribute to the design research by indicating possible relationships between music and creativity in the design process. This study will also show design educators and design practitioners whether music listening has an effect on the cognitive actions of designers during the design process. Determining if there is a relationship between levels of creativity and music listening may help develop new or modify current teaching methods for studio classes and implementing changes in the environment of professional design studios.

CHAPTER TWO

REVIEW OF LITERATURE

Design process as cognitive process

Numerous design researchers recognized the need to integrate cognitive psychology findings into the design process research. In the 1950s the design process was first designated as a cognitive process. It was not until three decades later that researchers realized the importance of this designation (Coley, Housman and Roy, 2007). The number of studies on this issue has increased showing a consensus between the researchers that the design process should be seen as cognitive process (e.g. Akin & Lin, 1995; Gero & Mc Neil, 1998; Purcell & Gero, 1998; Bilda & Demirkan, 2003; Goldschmidt & Smolkov, 2006; Suwa, Purcell & Gero, 2006; Coley, Houseman & Roy, 2007). Many of these studies investigated the behaviors of designers during the design process using techniques and theoretical constructs of cognitive psychology in general and protocol analysis in particular. This approach toward researching the design process led to demystification of the process itself and its properties enabled the potential for investigating different aspects of the design process and helped answer different research questions and formulate new ones.

A group of design studies utilizing theories and techniques of cognitive psychology, provided answers to further understand the design process. For instance, recording and analyzing artifacts of cognitive processes involved in the design process (sketches and verbal protocols) helped researchers to determine whether traditional design media had advantages over digital media (Bilda & Demirkan, 2003). Heylighen, Deisz and Verstijnen (2007) examined if there is qualitative difference in the design product, in the situation when the designer develops a single

solution versus the designer searching for several alternative solutions. In order to relate cognitive strategies to creativity and quality of design solutions, Kruger and Cross (2006) used the protocol data analysis to identify different cognitive strategies which employed by the designers. Menezes and Lawson (2006) explored how novice and advanced design students perceive conceptual sketches. Many studies developed different schemes for coding designers' cognitive actions from video/audio design protocols (e.g. Akin & Lin, 1995; Gero & Mc Neil, 1998; Suwa, Purcell & Gero, 2006).

Literature suggests that in today's design community cognitive psychology is a common approach in design research. A wide range of design studies contribute to the understanding of cognition within design. Researchers, who were examining designers' creativity, consciously integrated psychological theories in their studies. The studies presented in this chapter confirm the importance of using cognitive psychology findings in design process research.

Creative cognition: Discussion of theoretical context

The following discussion focuses on the theoretical concept in creativity research. The intention is to present theoretical grounds which will be utilized for this study. The cognitive approach (Finke, Ward & Smith, 1996) has sought to understand the mental representation and processes underlying creative thinking. This cognitive approach was developed by Finke, Ward and Smith in the beginnings of the 1990's, and has been accepted in the design and other research communities since.

Finke, Ward and Smith (1996) developed the "general theory of creativity" model that relates cognitive processes and the resultant creative products. The model can provide an

understanding of how creativity is expressed in a design. The model is called the Geneplore Model, because it considers both generative and exploratory cognitive processes. According to the Geneplore Model there are two phases in the creative cognitive process: generative and exploratory (Figure 2).

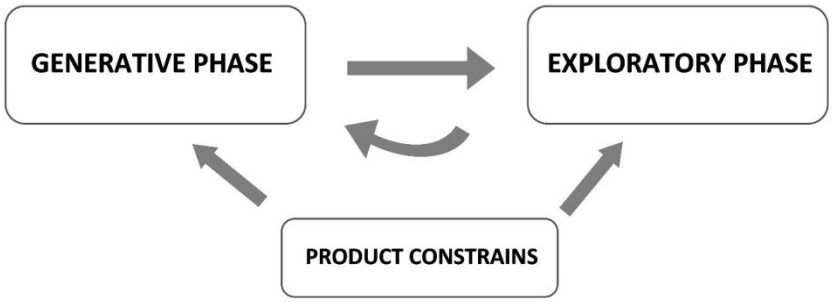


Figure 2. Basic structure of the Geneplore model.

In the generative phase (the preliminary phase) a person constructs preinventive structures with its properties, based on mental images. The preinventive structures and its properties are then further examined in the exploratory phase where a person seeks to find meaningful ways for the preinventive structures and its properties. The preinventive structures can be generated, regenerated, and modified during the entire creative exploratory process. One can find a satisfactory solution quite rapidly, thus the whole creative process may be linear. However, if these explorations are unsuccessful, the process will return to the generative phase (the preinventive structure would be abandoned and a new one would be generated) or one would modify the original structure and then repeat the exploratory phase with this modified structure. The creative cognitive process begins with a cycling between the two phases, and it lasts until a person finds a satisfactory solution.

Scholars interested in creativity used the creative cognitive approach as a theoretical concept for their studies. For example, Heylighen, Deisz, and Verstijnen, (2007) used the model as a theoretical framework in their research and as a basis for their experiment. They wanted to find out which approach to design could result in more original solutions; designers who consciously develop one design solution or in the other case, deliberately search for multiple alternatives before selecting one. In addition, Roskos-Ewoldsen, Black, and McCown (2008), adopted the Geneplore Model and measured two phases of creativity that the concept suggests—generating and exploring the implications of an idea. The Geneplore Model was exploitable for those scholars who were interested in the creativity phenomenon and its processes (Freyd, 1994; Batey & Furnham, 2006). Others were employing the model for supporting their own claims. For example, Purcell and Gero (2006) used the phases that the model proposes while they were trying to determine particular implications of working memory, imagery reinterpretation and mental synthesis on the role of sketching in design.

Finke et al. (1996) developed the Geneplore Model stating that creativity can be enhanced by the utilization of creative strategies for problem solving, which is a part of the creative cognition concept. Finke and his associates considered visual metaphor usage as a good problem-solving technique. Finke (1990) demonstrated that people are capable of making creative visual discoveries in imagery and that these discoveries are strong cognitive resources, which people could use for inventive thinking. Although not the first to conduct experiments on mental synthesis, Finke's work inspired many scholars to carry out their own experiments on creative mental synthesis. According to Purcell and Gero's "Drawing and the design process", mental synthesis plays an important role in the design process in general and in sketching as part of it. Goldschmidt and Smolkov (2006) also exploited the Geneplore Model when they were

examining how different kinds of visual stimuli affected the solving of dissimilar design problems. The findings suggested that the effect of visual stimuli is dependent on the type of design problem being solved. As presented above, Finke's work inspired and influenced research that followed.

The outcome of the creative cognitive process is a creative product (Finke et al., 1996). In this study a creative product will be regarded as an artifact of the cognitive process (drawings), thus it represents the focus for observation and examination. This study attempts to observe the levels of creativity embodied in the final creative products.

Creativity and creative assessment technique

Creativity is a natural part of many human activities, including science, medicine, philosophy, education, law, management and others. Numerous researchers have tried to define and categorize creativity. Lawson (2006) underlined that creativity in design involves periods of very intense work and the relation of many, often incompatible, or at least conflicting demands. According to Lawson, "Most people would describe design as one of the most creative of human pursuits" (Laeson, 2006, p.145). Bonnardel (2000) believes that creativity takes place in a "constrained cognitive environment." In contrast, Cross (1997) reported several studies where he examined the idea of the 'creative leap' (arising from sudden illumination), the manner in which he saw creativity. Cross (1997) viewed creative design in relation to product-creativity, rather than process-creativity. Finke et al. (1996) considered creativity as a product or outcome of many mental processes. It is apparent that agreement on creativity in the literature does not exist. A universal categorization and definition of creativity is hard to define.

Although the consensus for a universal definition of creativity does not exist, many scholars agree that creativity can be seen and measured in a creative product. In other words a creative product is an artifact of the creative process and thus embodies a creative dimension that can be observed and measured. The authors of the Geneplore model (Finke, Ward & Smith, 1996) believe that creativity should not be investigated, observed or measured in the person nor in the process, it should be measured in a product. Hennessey & Amabile (1999) would also rather examin**e** the creative product than the creative process as the object of investigation.

The researchers mentioned above agree that creativity can be observed in the final product, hence the question arises: what is the method for effective measurement of levels of creativity in a creative product? Dollinger and Shafra (2005) stated that a standard method for the assessment of creative products is the consensual assessment technique. The consensual assessment technique presents a standard and a widely accepted method of assessing creativity in products (Dollinger & Shafra, 2005). The CAT has been used in different experiments in a wide range of areas, for example in assessing verbal and visual art products, evaluating movies, drawings, creative writing, etc. (Amabile, 1982; Chen, Kasof, Himsel, Greenberger & Xue, 2002; Kaufman, Gentile, & Bear, 2005; Plucker, Kaufman, Temple, & Qian, 2009).

The consensual assessment of creativity was designed and developed by Amabile (1982), in the work of social psychology of creativity. According to Amabile, for the purpose of empirical studies, researchers should abandon the hope of finding objective criteria for defining creativity and, instead, adopt a definition that relies clearly upon subjective criteria. The technique rests on two assumptions. The first assumption is that it is possible for an appropriate group of judges to obtain reliable judgments of product creativity. In other words, creativity in a product may be hard to define in terms of specific properties, but it is something that the

appropriate group of judges can recognize when they see it and agree with one another on the perception. And the second assumption is that there are observable levels of creativity, that some products are more or less creative than others. So, the creativity assessment technique is grounded in a consensual definition of creativity:

> A product or response is creative to the extent that appropriate observers independently agree it is creative. Appropriate observers are those familiar with the domain in which the product was created or the response articulated. Thus, creativity can be regarded as the quality of products or responses judged to be creative by appropriate observers, and it can also be regarded as the process by which something so judged is produced. (Amabile, 1982, p.31)

There are those which employed the CAT as a source for developing their own theories or assessment methods (Batey, & Furnham, 2006; Epstein, Schmidt, & Warfel, 2008). Significant groups of studies utilized the CAT as an instrument for evaluation of creative products (e.g. Chen et al., 2002; Kaufman et al., 2005; Plucker et al., 2009). Usually the CAT was selected because it is a common method for the measurement of creative products (Plucker et al., 2009). Many studies were conducted in order to develop or to extend the CAT (Baer, Kaufman, & Gentile, 2004; Dollinger, & Shafran, 2005; Kaufman, Bear, Cole, & Sexton, 2008). Kaufman et al. (2008) were referring to the CAT that, "In study after study, these expert ratings, done completely independently of one another … have yielded quite satisfactory interrater reliabilities that typically exceed .70 and often range as high as the .90s" (p.172).

Hennessey and Amabile (1999) presented several features the methodology requires. First, judges should be asked to rate open-ended tasks. Then, the creative task should not depend greatly on certain particular skills and it should allow for novelty in solution. Finally, the task

must lead to a solution which is clear, observable and as such can be assessed by judges. Requirements for the assessment procedure asked that judges should be familiar enough with the domain in question, make their assessments independently and rate other dimensions in addition to creativity. Judges should be instructed to rate the products relative to one another rather than against some absolute standards. The Consensual Assessment Technique also requires that scores be analyzed for interjudge reliability. The most important criteria is that the ratings are consistent and reliable (Hennessey and Amabile, 1999). If appropriate judges independently agree that a given product is highly creative, the product can be accepted as such.

Several limitations of the consensual assessment technique are identified (Hennessey & Amabile, 1999). The CAT takes a lot of preparation, for the experiments which are pressed for time the technique is not appropriate. Furthermore, it would probably be very hard to apply this method to those creative products that possess a revolutionary character. It is possible that these creative products, which are extraordinary and new, would make it difficult for even experts to agree on the level of their creativity. Finally, it is obvious that judgments gained by this method are limited in the sense that they are made in their respective historical context.

Drawings as artifacts of creative cognition

According to Purcell and Gero (1998) drawings are the visual display of mental images. They are evidence of how a designer thinks. Drawings play a great role in presenting a potential design. From a cognitive science perspective, Goel (1995) considers drawings as representations of an external symbol system. The author designates drawings as artifacts of the creative cognitive process; in other words they are representations of a shift from verbal to graphical

information. Lawson (2004) thinks as well that drawings could be viewed as a window into the designers' mind and cognition system.

According to Bryan Lawson (2004) the modern designer does not experiment with the design (the item, the object) itself but rather with representations of it. He was discussing the knowledge that drawings embodied and he was concerned with the type of insights the drawings could offer about the designers' knowledge system. The classification of drawings, as done by Lawson (2004), was based on the fact that the drawings represent the knowledge that designers work with. Each of the classification types has its own set of rules that are apparently part of the knowledge. The types of drawings identified by Lawson (2004) include presentation drawings, instruction drawings, consultation drawings, experiential drawings, diagrams, fabulous drawings, proposition drawings and calculation drawings.

This study will look more closely into the proposition drawings, one type designated by Lawson (2004). He stated, "The propositional sketch becomes a sort of graphical 'what if' tool" (Lawson, 2004, p.53). This is the point in the design process where a designer externalizes some features of the design solution in order to examine them in a more focused way. The proposition drawings encapsulate the dimensions of the proposed design solution. They can be useful for presenting the drawings in a more organized way to the other individuals interested in the design solution. In this study the proposition drawings were regarded as a data source. Proposition drawings provide a good sample foe examining and hence will be investigated in this study.

Emotions Influence Creative Cognition

Emotional states systematically influence performance on many cognitive tasks (Isen, Daubman & Nowicki, 1987; Ashby, Isen & Turken, 1999). Isen at al. (1987) conducted four

experiments that indicated that a positive effect improved performance on creative cognitive tasks. The participants, who were exposed to a few minutes of a short comedy film or a small gift of candy, showed improved performance in solving creative tasks. At the same time, a negative affect (a depressing movie) was introduced to the other participants who failed to show improvements in creative performance. According to the results presented in this study, creativity can be enabled by a pleasant state of mood. The authors stated that, "creativity can be fostered by appropriate modification of the interpersonal environment" (Isen at al., 1987, p. 1128). Moreover, good feelings increase the tendency to combine cognitive material in new ways and more possible ways of relating and combining them. Pannells and Claxton (2008) studied the relationship between happiness and creative ideation, the process of forming ideas. Results indicated that there was a significant positive relationship between happiness and creative ideation, which supported their hypothesis. According to the authors, happiness affects creative thinking.

This finding is supported with the neuropsychological theory of positive affect (Ashby at al., 1999). The authors assume that positive affect is associated with increased brain dopamine levels. The theory further presumes that the resulting elevated dopamine levels influence performance on a variety of cognitive tasks (e.g. creative problem solving). However, Ashby et al. (1999) do not assume that a positive affect simply turns dopamine on or off; they believe that moderate levels of dopamine are present even under neutral affect conditions. The induction of a positive affect is assumed to only slightly increase these normal dopamine levels. According to the authors, the theory when applied to creative problem solving assumes that creative problem solving is improved, in part, because increased dopamine is released in the anterior cingulated, which improves cognitive flexibility and facilitates the selection of cognitive perspective.

Music and its effect

Numerous music studies indicated the existence of a relationship between music and emotional state of being (e.g., Hodges, 2000; Lesiuk, 2005; Nater, Abbruzzese, Krebs and Ehlert, 2005; Ullmann Fodor, Schwarzerberg, Carmi, Ullmann and Ramon, 2008). Natar et al. (2005) examined the differential reactivity to two musical stimuli that elicit distinct psychological and physiological reaction. Heart rate, electro-dermal activity, skin temperature, salivary cortisol, salivary alpha-amylase, and psychological variables were followed during the course of the whole study. Participants were fifty three healthy students. According to this study music stimulates physical and psychological changes in a person. According to the authors, music is a powerful emotion-eliciting stimulus. Music evokes emotions that come with specific physiological response pattern in a variety of biological variables. Ulman et al. (2008) investigated the attitude of the operating room staff towards listening to music during surgery. According to this study, the majority of the staff believed that music had a positive effect on them while working in the operating room. Study of Oldham, Cummings, Mischel, Schmidtke and Zhou (1995) showed that randomly selected employees working on 32 jobs in the office of a retail organization who used stereo headsets at work exhibited significant improvements in performance, turnover intentions, organization satisfaction and mood state.

Past music studies suggest that music can produce different kinds of feelings for individuals who partake in music listening. Fiske (1996 as cited in Lesiuk, 2005) noted that the mood states following music listening are the results of an individual's unique past experiences. Essentially, state of being, as an outcome of music, is a result of individuals projecting their many past experiences of the tonal-rhythmic events presented in music. The state of being usually refers to waking of emotions and relaxation. Stratton and Zalanowski (1984) reported a

significant correlation between degree of relaxation and preference for music. Studies that explored influence of music on levels of anxiety and on creative task performance were reported by Teresa Lesiuk (2000; 2005). She provided evidence that music listening can influence the mood state of computer information systems developers. Participants in Lesiuk's (2005) study were fifty six computer information systems developers, from different companies located in two cities. This quasi-experimental field study lasted over five weeks in participants' natural work environment. Two main findings were reported: the level of state anxiety decreased when music was used prior to and throughout a computer programming task, and that state of being, in this case positive feelings, and quality of work were lowest with no music.

Summary

In this chapter, the design process was identified as consisting of creative cognitive actions and phases. Further it was presented that cognitive material can be influenced by emotional state of being, and also that the emotional state of being can be influenced by music listening. For the purpose of this study, findings presented above will be considered within the context of the Geneplore model, which is proposed as one example of a general model of creative cognition that presents a theoretical grounding for this study. The knowledge from different disciplines presented above leaves room for the development of a hypothesis that music has indirect effect creativity in the design process. In order to examine this hypothesis an empirical study has been developed, which included an experiment, conducted in laboratory conditions and procedures of the consensual assessment technique for the purpose of measuring perceived creativity and the other dimensions of the design solutions created by a selected group of undergraduate interior design students.

CHAPTER THREE

RESEARCH DESIGN AND METHOD

This study investigates the relationship between levels of creativity of a final design product and listening to music during the design process. For the purpose of this study presentation drawings will be regarded as final design product. In this study drawings are evidence of how a designer thinks through an idea. The aim of the research is to answer the question: does the introduction of music stimuli influence perceptible levels of creativity of a final design product?

An experiment was conducted on student performance on the assigned design task with and without music stimuli. The experiment was designed to test the hypothesis. It had two parts, an initial pilot experiment followed by the main experiment. Seventeen undergraduate interior design students created designs and presented them in presentation drawings, in orthographic and perspective views. Students' designs were then reviewed and rated by outside judges using the Consensual Assessment Technique (Hennessey & Amabile, 1999) in order to determine levels of creativity perceived in the design products.

Pilot experiment – testing method

The pilot experiment was conducted in Belgrade, Serbia, in August 2009. In the pilot experiment, the participants were two students enrolled in their fifth year of the Interior Design program at the Faculty of Applied Arts, University of Arts in Belgrade, Serbia. The experiment lasted for two days, four hours each day. The students were asked to design one piece of furniture using two basic geometrical forms (box and cylinder). There were no restrictions or

limitations in customization of the shapes. The dimensions and materials specified in the final solution were left to the participants' preference. One randomly selected participant was asked to listen to music, while the other one was asked not to during entire design process. It was left to the music listener to create her own music library and to choose music according to her own preference. A panel of judges, consisting of five interior design graduate students, ranging with design experience of three to seven years, rated the design products. All five judges were from the Interdisciplinary Design Institute at Washington State University in Spokane, WA (WSUS-IDI). The method chosen for rating in the pilot study was the consensual assessment technique.

The purpose of the pilot experiment was to examine the feasibility and appropriateness of the method and to discover its weaknesses and strengths. The pilot experiment was essential for the design of the main experiment particularly in the area of participant selection, the design task, the creativity assessment and finally in overall experiment organization. The pilot experiment showed several weaknesses, which were addressed in the design of the main experiment. The weakness of the following elements was modified: participant sample, time-on-task, design task and modification of the Consensual Assessment Technique for the purpose of reflecting the objectives of the study. The main experiment was altered to address the problems that became apparent during the pilot experiment. The changes which occurred were the number of participants and defining a more appropriate design task.

Main experiment description

Following the pilot experiment, a main experiment was conducted on student performance on the assigned design task with and without music stimuli. The participants were seventeen (17) undergraduate design students enrolled in the final, fourth year of the Interior

Design program at Washington State University in Spokane. The participants were recruited from the three design studios. The final sample consisted of four male participants and thirteen female participants. All participants were in their early twenties. The participants did not get any money or any academic credit for their work. Participation of all participants was on voluntary basis. It was introduced to them that the only benefit, if they chose to part in this experiment, was additional professional exercise and contribution to the design research. The participants were asked to work on the design task, in experimental conditions, in two design sessions, with two days in between (Figure 3). It is also worth noting that the first design session was conducted on Friday, and the second one was conducted on the following Monday.

Figure 3. The experiment. Image 1 – first session. Image 2 – second session.

The design task

The design task was modeled after Finke's (1990) creativity task. The design task (problem or assignment) developed for this study was designed to be challenging, realistic, appropriate for the participants, not too complex, and feasible in the available time. Finke's creativity task was created for non-designers; therefore the task was modified to be more

appropriate to the participants design background. The modifications were done under guidelines presented by Goel (1995) and requirements of the Consensual Assessment Technique (Amabile, 1982; Hennessy & Amabile, 1999). According to the CAT the participants should be presented with a task, which leaves room for flexibility and novelty of response, and the task should lead to a clearly observable product. The creative problem should be ill-defined (Ward, Finke & Smith, 1996). According to Goel (1995) the features of design task are:

1. Availability of information: The start state is incompletely specified, the goal state is even less, and the transformation function from the start to goal states is completely unspecified.
2. Nature of constraints: According to Goel (1995), there are two types of constraints: (a) nomological and (b) social/political/legal/economic, and such. Nomological constraints are dictated by natural law, they are hard and non-negotiable. In fact, they are of most influence on the design solution. The second set of constraints is very complex. However, what is of importance here is that the constraints are not constitutive or definitional. They are, compared to the first set, negotiable.
3. Size and complexity of problems: Design problems are generally large and complex, requiring days to months to complete, however the task will be adjusted in size and complexity due to the experiment's time.
4. Component parts: Any problem of any size and complexity has parts. Being large and complex, design problems have many parts. But little in the structure of design problems dictates the lines of decomposition. Decomposition is dictated by the practice and experience of the designer.

5. Interconnectivity of parts: The components of design problems are not logically interconnected. There are many contingent interconnections between them.
6. Right and wrong answers: Design problems do not have right and wrong answers, only better or worse.
7. Input / Output: The input to design problems consists of information about the type of the design or the design behavior the artifact/process needs to facilitate in order to satisfy specific goals. The output consists of the artifact specification. Functional information mediates between the input and output information.
8. Feedback loop: There is no genuine feedback from the world during the problem-solving session. It has to be simulated by the designer in the internal problem-solving session. Real-world feedback comes only after the design is completed and the artifact is constructed and allowed to function in its intended environment. At this point the feedback cannot influence the current project.
9. Costs of errors: There are costs and penalty for being wrong in the real-world environment. Because of the nature of the task environment (experimental conditions) there will be no influence of this feature on the design nor on the task modification.
10. Independent functioning of artifact: The artifact is required to function independently of the designer. In our case, it will be required that the solution should be legible and understandable to the reviewers.

The design task developed and utilized in this study's experiment is presented in Appendix A. The experiment had two design sessions. In the first session, students were presented with15 items from Finke's creativity task, which were divided evenly in three groups (group A, group B and group C). The students were instructed to select an item from each group

which they then used to design a piece of furniture. In the first session they were asked to design a coffee table, which was defined as “a low table, usually placed in front of a sofa”. The participants could modify selected items at will, but it was required that each item remain recognizable in the final design solution. In the second session, the design task slightly changed and participants were asked to use the same three items, in order to design a bench this time. For the purpose of this experiment, a bench was defined as “a long seat for several persons”. All other requirements remained the same. The students were given a template to present their final design solution. The use of a uniform template was to insure that judges were looking at content and not distracted by graphic layout.

The experiment procedure

The experiment was conducted in a classroom of the WSUS-IDI (Figure 4). Envelopes containing design tasks and drawing paper were prepared in advance. The participants were asked to bring drawing and rendering tools, a scale, ruler, sketching paper and a personal music device. At the start of the first session participants were provided with an envelope and two papers of 12”x18” format. The design task and consent form were in the envelope. The participants had three (3) hours to find design solution and to draw and render it. It was left to the participants to decide how they will utilize the time assigned to them.

Figure 4. The experiment setting.

In the first session subjects were divided in two groups. One group consisted of those who worked with music stimuli for the duration of the design session, and the second group worked without music stimuli during the design session. The students from both groups were seated in a single room in alternating order shown in Figure 5. During the first session one person at each table was exposed to music stimuli while the other was not exposed. During the second session the use of music stimuli was reversed. By the end of the experiment each participant had worked with and without music stimuli. It is important to mention that the participants were instructed to listen to music of their own choosing. Music was intended to help create a certain comfortable interpersonal environment.

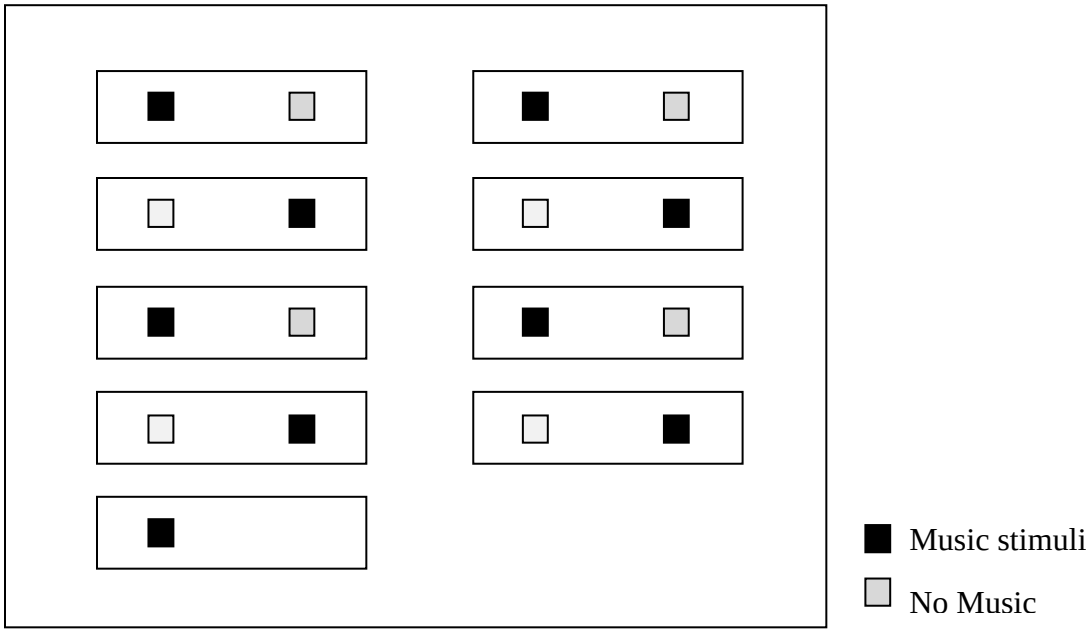


Figure 5. Seating organization of the participants in the first session.

At the end of each session students submitted the designs products folded in the envelopes along with the assignment. The envelopes were time and date stamped. Each student was assigned a number by the order in which they were submitting their design solution. Also each design solution received a code. The design created in the first session got the letter code "A" while the designs created in the second session got code letter "B".

At the end of the experiment an exhibition of the created works was designed. The exhibition included seventeen (17) design students, who produced thirty-four (34) design solutions. The exhibition lasted for four (4) days. The exhibition was designed for the purpose of judging. Each student's design solutions were exhibited in the same manner (Figure 6). Each judge could see the student number, design from the first session (A), and design from the

second session (B). There was no mark or any other way for the judges to tell which design solution was created under music stimuli or not.

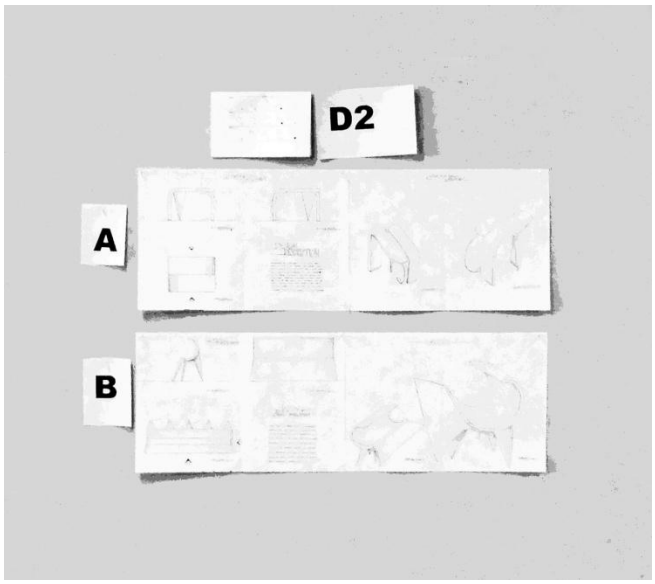


Figure 6. Format of design exhibition.

Analysis: Consensual Assessment Technique

The Consensual Assessment Technique (Amabile, 1982; Hennessy & Amabile, 1999) was utilized for measuring different levels of creativity of the final design product. According to Caroff and Besancon (2008), and Dollinger and Shafran (2005) the CAT is frequently used to measure the creative dimension of a product. The technique was modified in order to address specific conditions and needs of this study. Originally, the Consensual Assessment Technique was utilized in the assessment of artistic products and verbal products, namely artistic collages and poems (Amabile, 1982). Amabile (1982) introduced 23 different dimensions of a creative product to be evaluated, including creativity, technical goodness and aesthetic appeal. Several of the dimensions have been utilized in order to rate the creative product of this experiment. The

drawings for this case are representations of a piece of furniture. The dimensions were altered to reflect the nature of the creative products. In the Consensual Assessment Technique modifications of dimensions in relation to the creative product are common and do not compromise the reliability or effectiveness of the technique (Dollinger, Clancy-Dollinger, & Centeno, 2005; Plucker, Kaufman, Temple, & Qian, 2009).

The CAT includes a number of other dimensions in addition to creativity in order to provide inter-judge reliability and provide validity to the results, according to Amabile (1982) and Hennessy and Amabile, (1999). If the expert judges agree on creativity level of some product that level should be considered as the creativity level of the creative product. Amabile (1982) stated, "…it may be difficult to obtain ratings of aesthetic appeal and technical quality that are not highly correlated with ratings of creativity…it is important to demonstrate that it is at least possible to separate these dimensions. Otherwise, the discriminant validity of the measure is in doubt…" (p. 39). Essentially, if the dimensions of the creative products are not separated it could happen that judges might be rating something as "creative" just because they like it or for the reason it is technically well done. For the purpose of this study ten dimensions of reviewing creative products are utilized and modified. Namely: creativity, novel idea, creative application of materials, aesthetic appeal, pleasing placement of shapes, functionality, technical quality, neatness, effort evident and expression. The total mean of all dimensions was regarded as overall quality of the final design product. Even though CAT rates creativity and other dimensions of creative products, this study will solely focus on the ratings of the creativity dimension for each design product in order to test the general hypothesis.

Ten judges were recruited from the WSUS-IDI. Seven judges were interior design graduate students, all on their final year of master studies. Three judges were faculty members,

two professors from the Interior Design department and one professor from the Architecture department. Judges were provided with rating materials that consisted of the design task, cover letter (Appendix B) and scoring sheets (Appendix C). The judges were instructed to evaluate one student at a time comparing their designs solutions created in each session. Raters were also asked to rate one dimension at the time against both of the solutions. The dimensions were rated using a point scale, where one was "low", four was "mid" and seven was "high". Judges worked independently, they were not to consult each other or rate at the same time. They had four days to complete the evaluation process.

According to the Consensual Assessment Technique judges should be "appropriate observers, those familiar with the domain in which the product was created or the response articulated" (Hennessy and Amabile, 1999, p. 350). The judges were faculty members or students in their final year of either the interior or architecture design discipline. They conducted their assessment independently of one another. They also rated other dimensions in addition to creativity.

Analysis: Interjudge reliability

According to the Hennessy and Amabile (1999), a reliability figure should be .70 or higher in order that it could be concluded that the judges reached an acceptable level of agreement. When this level is reached, the next step is to calculate an average across all ratings given to each creative product. At that point the averages constitute the unit of analysis for further computations. The reliability was determined by calculating Cronbach coefficient alpha (α) (Hennessy and Amabile, 1999). This study analyzed interjudge reliability using Cronbach coefficient alpha to assess the internal consistency of the raters' responses.

CHAPTER FOUR

FINDINGS

The results are presented in two sections: the analysis of data related to computation of the interjudge reliability index and analysis of median score of the students' design solutions in creativity dimension assessed by the Consensual Assessment Technique. The participant's design solutions are presented in Appendixes E, F and G.

The paired-samples *t* test provided evidence that the hypothesis of relationship between music stimuli and creativity in the design process is inconclusive. The average scores were tested on the paired-samples *t* test, the test results showed that designs done without music stimuli scored lower (M = 4.88, SD = 1.84), while the designs done under music stimuli scored higher (M = 5.05, SD = 1.37). However, this difference was not statistically significant at the 0.05 level (p = 0.768). The direction of the means supports further research using more appropriate methods. This study is based on the assumption that one's state of being will influence their creative cognitive actions. However this study did not test this aspect. As seen in Figure 8, the number of students who performed better under music stimuli (7) was higher than the number of the students performed better without music stimuli (5). For the remaining five music stimuli had no effect. With this particular sample size n = 17, the post-hoc power analysis estimated that this study was unable to detect a false null for a medium to large effect (d > or = .5). Specifically, this study possessed a 62% chance of detecting a medium to large difference between the two groups. A sample of 27 would have been more appropriate to detect a medium to large effect of music stimuli and a sample of 71 would detect a small effect (d = .3).

Findings: Interjudge reliability

According to Hennessy and Amabile (1999) interjudge reliability is this method which is equivalent to construct validity. According to the authors, in order to compute the creativity level scores on creativity dimension it is important to establish interjudge consistency across all dimensions of each design. Interjudge reliability was analyzed using Cronbach's alpha to assess the internal consistency of the judges' responses. An interjudge consistency index was computed by "reliability" procedures in Statistical Package for the Social Sciences (SPSS). If interjudge reliability figure reaches .07 or higher, then the level of agreement should be considered as a high level of agreement (Hennessy and Amabile, 1999).

Table 1 shows that the judges have yielded assessments of high reliability of the design solutions. Each of the 34 design solutions was tested on reliability across all dimensions. In total there was a high level of agreement between judges across all dimensions of the final design product. After the indexes are calculated and after the acceptable level of the interjudge reliability is constituted, it is appropriate to proceed toward computation of the median across all ratings given to each product and more closely toward creativity dimension.

Student Number	*First Session*	*Second Session*
D1	0.72	0.83
D2	0.93	0.93
D3	0.71	0.88
D4	0.93	0.88
D5	0.91	0.87
D6	0.91	0.95
D7	0.87	0.85
D8	0.82	0.94
D9	0.79	0.90
D10	0.85	0.77
D11	0.80	0.60
D12	0.94	0.81
D13	0.93	0.92
D14	0.89	0.88
D15	0.87	0.65
D16	0.85	0.91
D17	0.78	0.86

Table 1. *Interjudge reliability statistics (Cronbach's alphas).*

Findings: Consensual Assessment Technique

The design product's median was computed from the dimension scores for each of 34 design products. Each design solution was assessed on a scale, where 0 is "low", 4 is "mid", and 7 is "high" (Appendix C). The data represent an ordinal scale. The median is appropriate measure of central tendency when the data represent an ordinal scale (Gay, Milles & Airasian, 2009). The final results are presented in Table 2 for the designs produced with music stimuli and in Table 3 for the designs produced without music stimuli. Looking more closely at both tables, specific pattern cannot be seen when comparing designs created with and without music stimuli. In both tables an equal distribution of scores is noticeable. Also, the score of 7 was the highest and 1 was the lowest score across all dimensions.

Student Number	*Creativity*	*Novel Idea*	*Material Application*	*Aesthetics*	*Shapes Placement*	*Functionality*	*Technical Quality*	*Neatness*	*Effort*	*Expression*	*Total Judgment*
D1	7	5.5	4	4	4	4	1	2.5	2.5	4	4
D2	4	4	4	4	4	4	5.5	4	4	2.5	4
D3	4	4	7	7	7	4	4	4	4	4	4
D4	7	7	7	7	7	7	7	4	7	7	7
D5	4	4	4	4	4	5.5	4	5.5	4	4	4
D6	5.5	4	4	2.5	4	4	4	4	4	4	4
D7	4	4	4	4	5.5	5.5	4	4	4	4	4
D8	4	4	4	5.5	5.5	7	7	4	7	5.5	5.5
D9	7	4	4	4	5.5	5.5	4	4	4	4	4
D10	4	2.5	1	4	4	4	4	4	2.5	2.5	4
D11	5.5	7	4	1	2.5	4	1	1	4	4	4
D12	1	1	1	1	1	4	1	1	2.5	1	1
D13	7	7	7	7	7	7	7	7	7	7	7
D14	7	7	7	5.5	7	7	7	7	7	7	7
D15	4	1	2.5	4	4	4	4	4	4	2.5	4
D16	7	7	4	7	7	4	4	4	4	4	4
D17	4	4	4	4	4	7	5.5	5.5	4	4	4

Table 2. *The medians of design products done under music stimuli across all dimensions.*

Student Number	Creativity	Novel Idea	Material Application	Aesthetics	Shapes Placement	Functionality	Technical Quality	Neatness	Effort	Expression	Total Judgment
D1	7	7	4	4	4	5.5	4	4	4	5.5	4
D2	4	5.5	4	4	4	1	4	5.5	4	4	4
D3	7	7	4	7	7	7	4	4	4	4	5.5
D4	4	4	4	4	4	7	5.5	7	4	4	4
D5	7	7	7	7	7	5.5	7	7	7	5.5	7
D6	4	2.5	1	1	1	4	1	1	4	1	1
D7	4	7	5.5	5.5	4	4	4	4	4	4	4
D8	7	7	5.5	7	4	5.5	7	5.5	7	7	7
D9	4	4	4	4	4	4	4	5.5	5.5	4	4
D10	1	1	1	1	1	4	1	1	2.5	2.5	1
D11	2.5	1	1	2.5	4	5.5	2.5	2.5	1	1	2.5
D12	4	4	4	1	2.5	2.5	1	1	4	1	2.5
D13	5.5	4	5.5	5.5	7	7	7	5.5	4	4	5.5
D14	7	7	7	5.5	5.5	5.5	4	4	7	7	6.25
D15	4	4	4	4	2.5	4	4	2.5	4	2.5	4
D16	4	4	4	4	4	7	4	4	4	4	4
D17	7	7	4	7	7	4	7	5.5	7	7	7

Table 3. *The median scores of design products done without music stimuli across all dimensions.*

For the purposes of testing this papers' general hypothesis, the dimension of creativity was individually examined in the final design product. Table 4 presents the median scores of the creativity dimension of all 34 designs: 17 designs done under music stimuli against 17 designs done without music stimuli.

Student Number	*No music stimuli*	*Music stimuli*
D1	7	7
D2	4	4
D3	7	4
D4	4	7
D5	7	4
D6	4	5.5
D7	4	4
D8	7	4
D9	4	7
D10	1	4
D11	2.5	5.5
D12	4	1
D13	5.5	7
D14	7	7
D15	4	4
D16	4	7
D17	7	4

Table 4. *The median scores in creativity dimension.*

The scores were tested on the paired-samples *t* test in SPSS. The results in Figure 5 indicated that the mean of design products done without music stimuli (M=4.88, SD= 1.84) are lower than of the design products done under music stimuli (M=5.05, SD=1.73), t=16, p=0.768. While the test score was lower when students not listening to music 4.88 (SD= 1.84) compared to when listened to music 5.05 (SD=1.37), this difference was not statistically significant at the 0.05 level (p = 0.768). Thus, based on this sample of 17 students, we can conclude that there is difference in students' test scores obtained while listening to the music or not listening to the music, however the difference is not statistically significant.

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	No music stimuli	4.882	17	1.8416	.4467
	Yes music stimuli	5.0588	17	1.73999	.42201

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	No music stimuli & Yes music stimuli	17	.085	.745

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	No music-Yes music	-.17647	2.42346	.58778	-1.42250	1.06956	-.300	16	.768

Figure 7. Results of the paired-samples *t* test.

The analysis of frequency is presented in Figure 8. Frequency refers to the number of students that scored higher with music stimuli, higher without music stimuli or stayed the same with and without music stimuli. The scores of the creativity dimensions were tabulated (Table 4) and also presented in a graph format (Figure 8). The number of students that performed better under music stimuli was seven. Five students performed better without music stimuli and the remaining five students had no effect on their scores whatsoever.

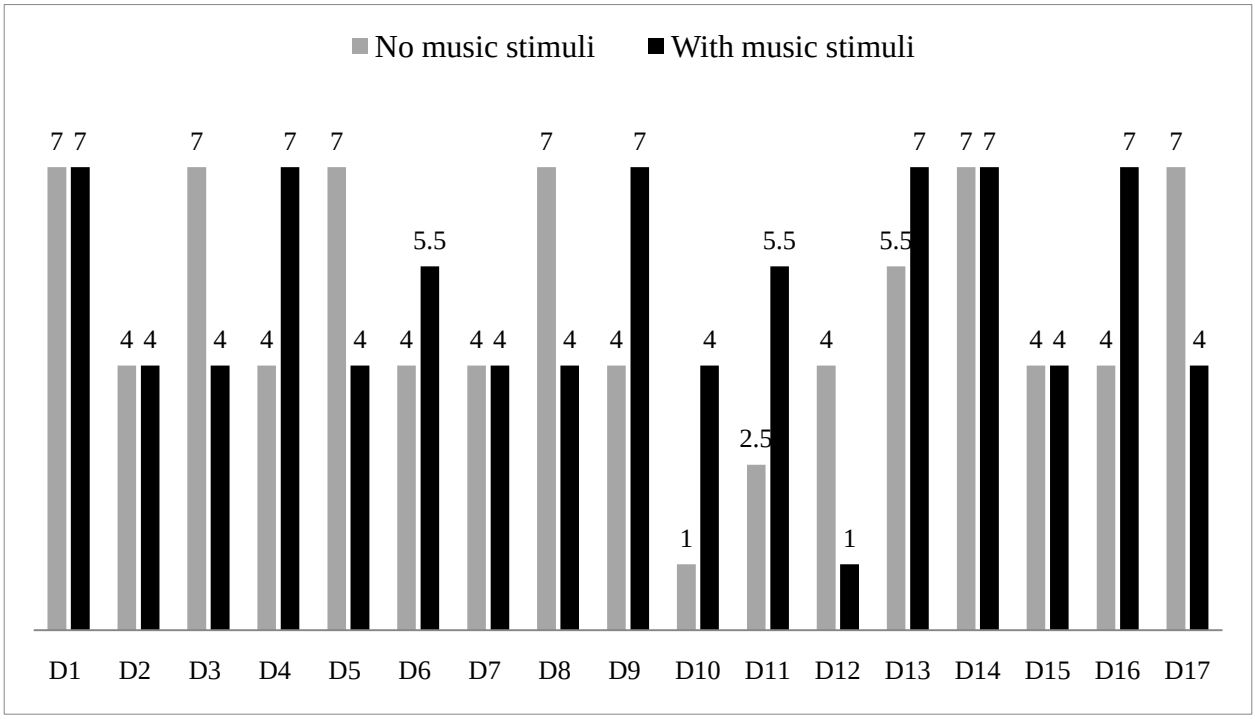
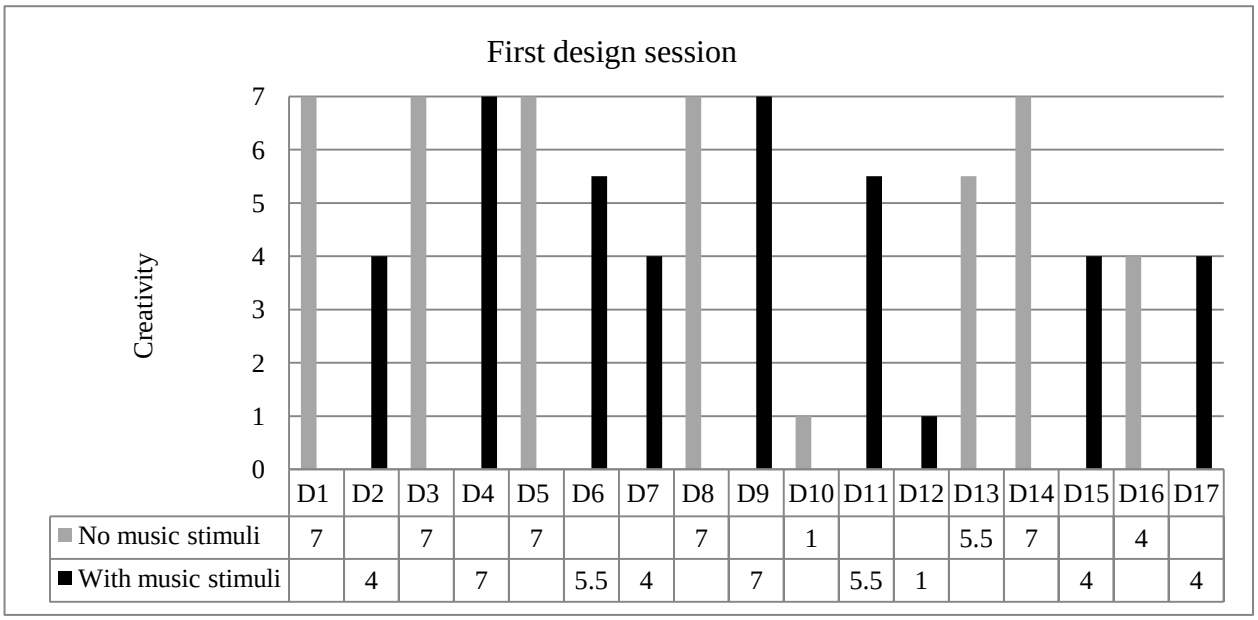


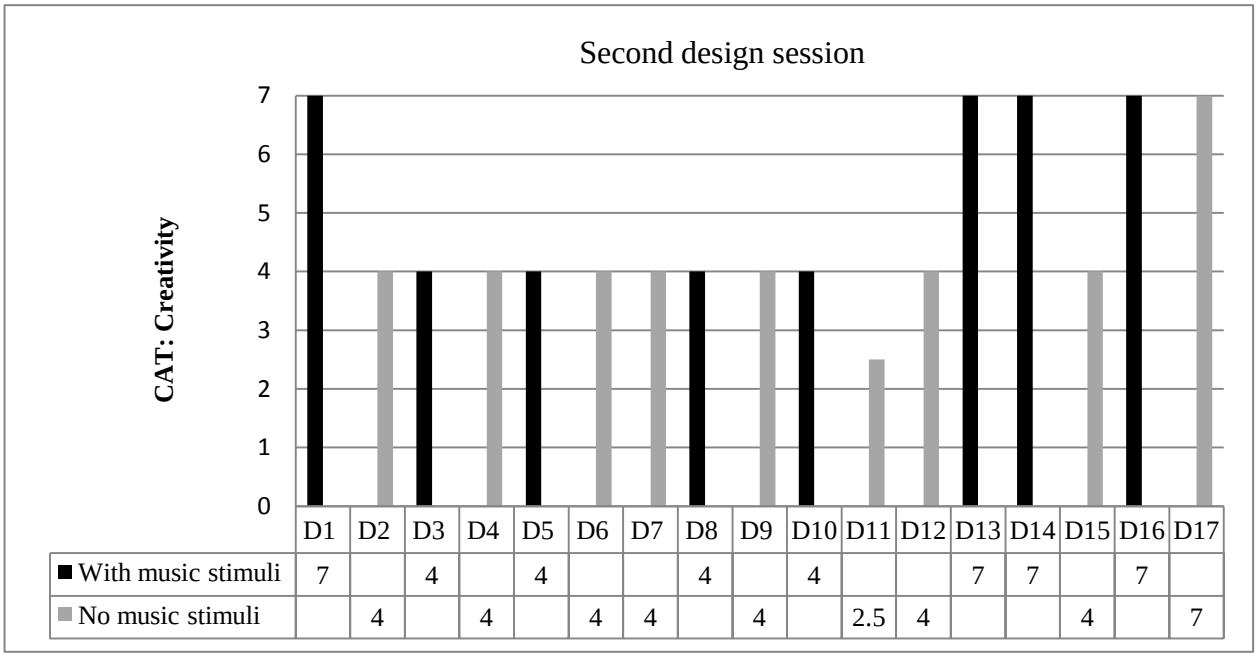
Figure 8. Median scores for 34 design solutions.

Data was also analyzed by comparing the graphs representing the first design session and the second design session in relation to music stimuli. The scores are presented in Figure 9 and Figure 10. The analysis showed that, when scores were totaled, the group of students who received music stimuli in the first session scored higher than their second session (from 7 to 5.5). On the other hand, the group of students which did not receive music stimuli in the first session, their score maintained the same in the second session (from 4 to 4).



	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17
No music stimuli	7		7		7			7		1			5.5	7		4	
With music stimuli		4		7		5.5	4		7		5.5	1			4		4

Figure 9. Median scores of creativity for designs in the first session.



	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17
With music stimuli	7		4		4			4		4			7	7		7	
No music stimuli		4		4		4	4		4		2.5	4			4		7

Figure 10. Median scores of creativity for designs in the second session.

Discussion on Findings

The hypothesis proposed in this study is that music listening has influence on state of being. This in turn affects the way cognitive material is organized, while the results could be observed in artifacts of the creative process. The findings obtained from the experiment presented above, point toward the inconclusiveness of the hypothesis; this study did not indicate the relationship between music stimuli and levels of creativity. There are studies which offer results that significantly differ from the findings provided by this study (e.g. Lesiuk, 2005). According to Lesiuk's (2005) findings, positive state of being, influenced by music, increased one's ability to perform better on creative task. Difference in results may be caused by variation of the environment and music stimuli introduction between these two studies, namely Lesiuk's study and this study.

The environment where the experiment is conducted is a very important variable which could influence the results. Observing Lesiuk's (2005) study, it is notable that the participants (56 computer information systems developers from different companies) were observed in their natural working environment, meaning they did not work under laboratory conditions. In her study no working environment was chosen as controlled. In her work she clearly stated that "it became evident that each company was very individual. The companies had their own work culture" (Lesiuk, 2005, p. 187). Compared to Lesiuk's study, this study's experiment was conducted under laboratory conditions in the classroom. When done under such conditions, more variables are under control, which could yield more reliable results. This premise may lead to questioning the previous study's results. Furthermore, Lesiuk's study did not have predefined exposure of the participants to music stimuli. The participants could choose to listen to music upon their own will, while in this study music stimuli were systematically introduced and

withdrawn. This is yet another variable which was under control in the current study, possibly giving more dependable findings.

Looking at time spent on task, the differences between the first session and the second session are noticeable. The participants spent two and one half hours on average on task in the first session, while in the second session they spent two hours on average. This drop in time spent on task was equal for all participants, notwithstanding the presence or absence of music stimuli. It presents itself clearly that music did not have any effect on this aspect of work performance.

In addition, there is a substantive fall in the average score from the first session to the second session. The average score in the first session was 5.5, while the second session scored 4. Aside from the drop in the average score, most participants' individual scores also decreased. Once again independent of music stimuli, the detected decrease leads to conclude that music stimuli did not have influence in this aspect either.

In this study music was related with the emotional state of being. As elaborated before, literature suggested that creative performance is related to emotional factors. Pannells and Claxton (2008) argued that happiness affects creative thinking. They suggested that happy individuals are more relaxed and more open to new experiences; therefore these individuals can make diverse associations, generate more ideas, or employ creative strategies without the tension of having to find a more creative solution. In addition, Finke et al. (1996) elaborated on the role of motivational factors which they relate to the concept of "intimate engagement" as an important precondition for successful problem solving. According to these authors, one needs to become deeply committed to and involved with a problem in order to solve it effectively. One needs to be involved personally in the creative idea in order to perceive the full richness of its

implications and possibilities. Consequently, the deeper involvement with the problem and stronger engagement would strengthen motivation and result in better problem solving. This study did not focus on motivation as a variable of influence. Motivation could be one of the reasons why the participants performed worse and spent less time on the task in the second session than in the first one.

The literature suggests that music stimuli do not influence everyone the same (Oldham et al., 1995; North et al., 2000; Lesiuk, 2005). In this study, students under numbers D2 to D12 show decrease of scores independent of music stimuli. Students D13 and D16 show improvement after music introduction, and the remaining students D3, D5, and D8 show dropping scores. According to North et al. (2004), an individual's relationship to music in everyday life is not necessarily characterized by deep emotional investment. Although Lesiuk (2000, 2005) identifies music as a cause for an increase in creativity levels of the creative product, it does not have to be so in every case. People consciously and actively use music in order to produce different psychological states (North et al., 2004). Oldham et al. (1995) found that people tend to improve work performance if they are exposed to music. However, the current study failed to examine the students' attitude toward music listening. Past studies (Oldham et al., 1995; North et al., 2000; Lesiuk, 2005) employed several methods for collecting data in order to explore the attitude toward music listening during work performance. Usually these methods relied on participants' responses to questionnaires or interviews. A future study should include this dimension in collecting data and then compare it with the results gained from the CAT.

For the purpose of testing this papers' hypothesis, the creativity dimension of the final design product was observed separately from other product dimensions. The results of other

dimensions are more or less similar to the creativity dimension, except for one. It is found that in the dimension of "pleasing placement of shapes", the number of students who performed better under music stimuli is much higher than in any other. Nine participants scored higher, compared to four who scored higher without music stimuli. Also, with four participants, music stimuli neither caused a positive nor negative effect. The "shape placement" dimension of the design product, created from three previously chosen items, is a direct outcome of the participants' process of mental synthesis. A similar observation was made by Finke (1990) when he explored the mental synthesis of three-dimensional items in forming images of whole, solid shapes, which can then be interpreted as new ideas for creative innovations. This study's finding concerning "shape placement" should be further examined in future research. Several questions arise, though. Is mental synthesis affected by music stimuli? What are the effects of music stimuli on the mental synthesis processes involved during the design process?

In summation, the findings of the current study reported in this chapter allow us to argue that music stimuli did not have an effect on creativity levels of the creative product. This conclusion is consequence of the fact that differences between the scores of the assessed design solutions done with and without music stimuli do not have statistical significance. In addition, music stimuli did not have any effect on the overall average score and on the time spent on task.

CHAPTER FIVE

LIMITATIONS

Music studies argued that state of being follow music listening; in other words, emotions are influenced by music. This study was conducted in order to examine the hypothesis, developed from literature, that music indirectly has an influence on levels of creativity in the design process. According to literature (Lesiuk, 2005), it was expected that the introduction of music stimuli would result in improvements in creative performance on a design task. Results of creative performance were observed and measured in artifacts of the design process. The results obtained from this study did not offer evidence that the relationship between music listening and creativity levels exists. This conclusion is supported by results from the paired-sample *t* test, along with findings in the aspects of time spent on task and average scores obtained from students in both sessions of the experiment. The following paragraphs will present limitations of this study regarding the experiment design and method and in relation with the CAT.

Experiment Design and Method Limitations

There are several areas for careful consideration regarding the research design that could be reconsidered in a future study, namely participant selection, sample size, the design task, and shifting from examining levels of creativity in the design product to examining creative cognitive actions in the design process.

The solving of design problems varies according to the experience of the designer (Lawson, 2006). This study recruited only design students. Design students have been found to follow a pattern of trial and error (Coley, et al., 2007). Experts, on the other hand have the capability of evaluating design concept as they occur, which reduces the time spent on the task

(Coley, et al., 2007). A future study could focus on experienced design practitioners and examine how they react to music stimuli during the design process.

Since this experiment was limited by sample size (17 participants) a future experiment should recruit more participants (a minimum of 27). As suggested in chapter four, sample size of 27 would have been more appropriate to detect a medium to large effect and 71 to detect a small effect.

The design of the task as a variable had the potential to influence the final results. The design task utilized in this study was based on the Finke's (1990) creativity task. Finke's creativity task was modified to satisfy the objectives of this study. Finke conducted his experiment with the hypothesis that creativity would be enhanced whenever one is forced to use unusual sets of items (Finke, 1990). These items were not originally made to be used by designers, because the participants in Finke's experiment were not designers. The introduction of different sets of items would probably result in a dissimilar outcome. Also, in current experiment the participants were asked to design two different pieces of furniture (one in each session) from three items used in both sessions. It should be considered in the future study to give the option to participants to choose three additional items for the second session. This could be important because this study showed that this strategy directly led to a decrease of time spent on task in the second session.

The creative cognition theory was introduced in this study, and later related to cognitive actions utilized in the design process. The recent focus of studies in design cognition has been through on the use of protocol studies (Kruger & Cross, 2006; Coley, et al., 2007). Protocol analysis originated as a technique for the analysis of problem-solving and examining creative cognitive actions involved in the design process (Coley, et al., 2007). It could enable a more in-

depth result through coding schemes. The literature noted that protocol or content analysis was the common way of examining the creative process of designers (Akin & Lin, 1995; Gero & Mc Neil, 1998; Purcell & Gero, 1998; Bilda & Demirkan, 2003; Goldschmidt & Smolkov, 2006; Suwa, Purcell & Gero, 2006; Coley, Houseman & Roy, 2007). Evaluating cognitive actions involved in the design process has become a popular method in design research for capturing, understanding, and analyzing design thinking. Future design research should consider measuring the quality, variety and complexity of the drawings emerged in the preliminary design phase. One should look more closely into types of drawings which Lawson (2006) called diagrams and experiential drawings. They both appear in the early phase and, according to Lawson (2006), they could offer a very important clue about both what designers know and how they think. The drawings appear to offer an infrastructure of the designers' thoughts and thinking processes (Lawson, 2006). Thus, this method could allow for a more in-depth look into the effects of music on creative cognitive actions and participants' behavior under music stimuli.

The present study did not employ any of the analysis methods mentioned above. This study looked more closely into the creative dimension of the design product. Although the design process consists of creative cognitive activities, this study made no observance of these activities. It was noticed in literature that creativity was researched through the creative product (e.g. Goldschmidt & Smolkov, 2006; Casakin, 2007), but also through creative cognition, i.e. cognitive actions involved in the design process (e.g. Dorst & Cross, 2001; Bilda & Demirkan, 2002, Kruger & Cross, 2006). Future studies should look more closely and gain insights on designers' creative cognitive actions employed during designing, with exposure to music stimuli.

Consensual Assessment Technique Limitations

The consensual assessment technique is a method for assessing creativity of the creative products utilized in this study. The Consensual Assessment Technique (CAT) provided interesting insights. The consensual assessment technique mimics the creativity assessment as it would be conducted in real life. It starts from a position that the researchers should abandon the hope of finding objective criteria for defining creativity and, instead adopt a definition that relies upon clearly subjective criteria (Hennessey & Amabile, 1999).

The CAT was initially used for assessing one creative product per subject; however it was later broadened, demonstrating that it is possible to assess differences between two designs created by one person (Hennessey & Amabile, 1999). It was shown that it is possible to reach an acceptable level of agreement between judges. The results presented in chapter four demonstrated that if one recruits judges (appropriate assessors) it is possible they will reach satisfactory level of agreement even though they did their evaluation individually and without inter consultation. It is worth noting that the judges did not have any kind of training prior to the evaluation, as was recommended (Hennessey & Amabile, 1999). From the inter-judge reliability results it can be seen that there was very high level of agreement across evaluated dimensions. Out of 34 rated design products, 27 of them returned a high level of agreement. In this case more than 27 designs had an index of 0.8, or higher. These results are in agreement with studies on the CAT, which always reported that is possible to reach a high level of agreement between judges (Amabile, 1982; Amabile, 1983; Hennessey & Amabile, 1999; Dollinger & Shafran, 2005; Kaufman et al., 2008; Caroff & Besancon, 2008). It was shown that a group of judges are able to identify differences between dimensions of two creative products created by one person, and then to achieve acceptable agreement on the assessment.

According to Hennessey and Amabile (1999), the CAT can be applied in situations calling for individual creativity assessment and in studies of the effects of environmental variables on creativity. In this study some limitations regarding the CAT's procedures were recognized. Firstly, this assessment technique is time-consuming. In situation where this study would require a quick assessment, this technique would not work. Secondly, it should be taken into account that the judges had to assess 34 designs, although they had four days to complete assessment it was noticed that they spent between one hour and two hours on judging. It is possible that time spent on evaluation exhausted the judges. This could have influenced the results. Furthermore, in the literature, not a single study was found utilizing consensual assessment technique for evaluating creativity of furniture design. Previous studies using this assessment technique evaluated less complex creative products, including art collages, poems, short movies, simple abstract drawings, paintings, and portfolio designs (e.g. Chen, et al. 2002; Horng & Hu, 2008; Crcinovic, 2009; Plucker, et al., 2009). Also, designing furniture asks for special consideration because it involves design and evaluation problems which are very complex. Because there are no prior studies examining the evaluation of furniture design ideas, this complexity may have affected the raters' response. Future studies should take this fact into account.

CHAPTER SIX

CONCLUSION

Researchers have long been concerned with the potential influence of music on work performance. The hypothesis that the relationship exists was developed from the implications found in the studies presented in the previous chapters. In this study the relationship between exposure to music stimuli and creativity levels assessed by independent judges is inconclusive, as no evidence emerged to that effect.

Besides music, there are also other factors that could influence designer's performance, such as motivation, age, noise, and also technical factors like lighting, thermal condition, comfort, etc. Prior studies looked at music as an important element of outer influence on work performance. This study has not proven such positions. It is recommended, therefore, that future studies broaden their foci to examine the influence of other factors on work performance, in conjunction with music or unconnected to it. This would be of special significance in the field of interior design. The hope is that design educators and practitioners will find this study valuable or at least informative, since it raised many questions that went beyond the frame of the topic itself. As the design field is rapidly developing, it is important for the educator and practitioner to keep abreast with new discoveries. In time, the picture will become clearer, and the field will benefit from what is learned from research.

BIBLIOGRAPHY

Akin, O., & Lin, C. (1995). Design protocol data and novel design decisions. *Design Studies,* 16, 211-236.

Ashby, F.G., Isen, A.M. & Turken, A. U. (1999). A neuropsychological theory of positive affect and its influence on cognition. *Psychological Review,* 106(3), 529-50.

Amabile, T. M. (1982). Social psychology of creativity: a consensual assessment technique. *Journal of Personality and Social Psychology, 43(5), 997-1013.*

Amabile, T. M. (1983). *The social psychology of creativity.* New York: Springer-Verlag.

Batey, M. & Furnham, A. (2006). Creativity, Intelligence, and Personality: A Critical Review of the Scattered Literature. *Genetic, Social, and General Psychology Monographs* (355-429). London: Heldref Publications

Bilda, Z., & Demirkan, H. (2003). An insight on designers' sketching activities in traditional versus digital media. *Design Studies,*24, 27-50.

Bonnardel, N. (2000). Towards understanding and supporting creativity in design-analogies in a constrained cognitive environment. *Knowledge-Based Systems,* 13, 505-513.

Caroff, X., & Besancon, M. (2008). Variability of creativity judgments. *Learning and Individual Differences.* 18, 367-371.

Casakin, H. P. (2007). Metaphors in design problem solving: implications for creativity. *International Journal of Design*, 1(2), 21-33.

Chen, C., Kasof, K., Himsel, A., Greenberger, E., Dong, Q., Xue, G. (2002). Creativity in Drawings of Geometric Shapes: A Cross-Cultural Examination with the Consensual Assessment Technique. *Journal of Cross-Cultural Psychology*. 33, 171-187.

Coley, F., Houseman, O., & Roy, R. (2007). An introduction to capturing and understanding the cognitive behavior of design engineers. *Journal of Engineering Design,* 18(4), 311-325.

Cross, N. (1997). Descriptive models of creative design: application to an example. *Design Studies,* 18, 427-455.

Dollinger S. J., Clancy-Dollinger, S. M., Centeno, L. (2005). Identity and creativity. *Identity,* 5(4), 315-339.

Dollinger, S. J., & Shafran, M. (2005). Note on consensual assessment technique in creativity research. *Perceptual and Motor Skills,* 100, 592-598.

Dorst, K., & Cross, N. (2001) Creativity in the design process: co-evolution of problem – solution. *Design Studies,* 22, 425-437.

Hennessey, B. A. & Amabile, T. M. (1999). Consensual assessment. *Encyclopedia of Creativity,* 1, 347-359.

Heylighen, A., Deisz, P., & Verstijnen, I.M. (2007). Less is more original? *Design Studies,* 28, 499-512.

Hodges, D.A. (2000). Implications of music and brain research. *Musical Educators Journal, 87*(2), 17-22.

Isen, A.M., Daubman, K.A., & Nowicki, G.P. (1987). Positive affect facilitates creative problem solving. *Journal of Personal and Social Psychology,* 52(6), 1122-1131.

Epstein, R., Schmidt, M. S., & Warfel, R. (2008). Measuring and training creativity competencies: validation of a new test. *Creativity research journal,* 20(1), 7-12.

Finke, R.A. (1990). *Creative imagery: Discoveries and Inventions in visualization.* New Jersey: Lawrence Erlbaum Associates.

Finke, R. A., Ward, T. B. & Smith, S. M. (1996). *Creative cognition: Theory, research, and application.* MIT Press, Cambridge: MA. Retrieved October 21, 2009, from NetLibrary database.

Freyd, J. J. (1994). Circling Creativity. *American Psychological Society,* 5(3), 122-126.

Gero, J. S., & Mc Neil, T. (2006). An approach to the analysis of design protocols. *Design Studies,* 19, 21-61.

Goel, V. (1995). *Sketches of thought.* Cambridge, Mass., MIT Press.

Goldschmidt, G. & Smolkov. M. (2006). Variances in the impact of visual stimuli on design problem solving performance. *Design Studies,* 27, 549-569.

Goldschmidt, G., & Weil, M. (1998). Contents and structure in design reasoning. *Design Issues,* 14(3), 85-100.

Jaarsvelda, S. & Van Leeuwenb, C. (2005). Sketches from a design process: Creative cognition inferred from intermediate products. *Cognitive Science*, 29, 79-101.

Kaufman, J. C., Bear, J., Cole, J. C., & Sexton, J.D. (2008). A comparison of expert and nonexpert raters using the consensual assessment technique. *Creativity Research Journal,* 20(2), 171-178.

Kruger, C. & Cross, N. (2006). Solution driven versus problem driven design: strategies and outcomes. *Design Studies,* 27, 527-548.

Lesiuk, T. (2000). The effect of music listening on a computer programming task. *Journal of Computer Information Systems*, 40(3), 50-7.

Lesiuk, T. (2005). The effects of music listening on work performance. *Psychology of Music,* 33(2), 173-191.

Lawson, B. R. (2004). *What designers know.* London, Architectural Press.

Lawson, B. R. (2006). How designers think. London, Architectural Press.

Menezes, A.,& Lawson, B. (2006). How designers perceive sketches. *Design Studies,* 27, 571-585.

Nater, M., Abbruzzese, E., Krebs, M. & Ehlert, U. (2006, November). Sex differences in emotional and psychophysiological responses to musical stimuli. *International Journal of Psychophysiology, 62*(2), 300-308.

Oldham, G.R., Cummings, A., Mischel, L.J., Schmidtke, J.M., & Zhou, J. (1995). Listen while you work? Quasi-experimental relations between personal-stereo headset use and employee work responses. Journal of Applied Psychology, 80 (5), 547-564.

Pannells, T. C. & Claxton, A. F. (2008). Happiness, creative ideation and locus of control. *Creativity Research Journal,* 20(1), 67-71.

Pedgley, O. (2007). Capturing and analyzing own design activity. *Design Studies,* 28, 463-483.

Plucker, J. A., Kaufman, J. C., Temple, J. S., & Qian, M. (2009). Do experts and novices evaluate movies the same way?. *Psychology & Marketing,* 26, 470-478.

Purcell, A. T., & Gero, J. S. (1998). Drawings and the design process. *Design Studies,*19, 389-430.

Roskos-Ewoldsen, B., Black, S. R., & McCown, S. M. (2008) Age-related changes in creative thinking. *Journal of Creative Behavior*, 42, 33-59.

Stratton, V.N., & Zalanowski, A.H. (1984). The relationship between music, degree of linking, and self-reported relaxation. *Journal of Music Therapy*, 21(4), 184-192.

Suwa, M., Purcell, T., & Gero, J. (1998). Macroscopic analysis of design processes based on a scheme for coding designers' cognitive actions. *Design Studies,* 19, 455-483.

Ullman, Y., Fodor, L. Schwarzberg, I. Carmi, N., Ullman, A. & Ramon, Y. (2008). The sound of music in the operating room. *Injury-International Journal of the Care of the Injured*, 39(5), 592-597.

APPENDIX

Appendix A – Study Student Design Assignment

WASHINGTON STATE UNIVERSITY

Interdisciplinary Design Institute

Spring 2010

Student name (printed): _____

YOU ARE ASKED *(NOT)* TO LISTEN TO MUSIC DURING THE ENTIRE DESIGN SESSION

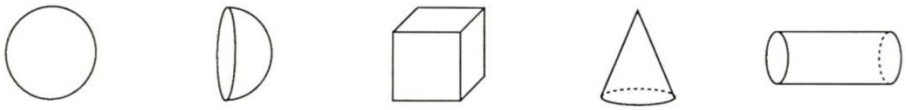
DESIGN TASK:

Please select **three (3) items** presented below by checking the boxes. Select one form from each group - **Group A, Group B, Group C**. Once your decision is made, you cannot change the selected items.

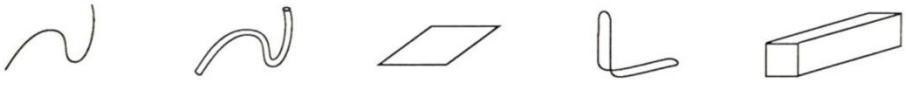
After the selection, use **all three items** to design a **COFFEE TABLE** - a low table, usually placed in front of a sofa. **Dimensions** of the coffee table should not exceed: **Length: 36" / Width: 36" / Height: 20".** Identify materials in your final design solution. (***For the second session****: Use the three (3) items (selected on the first design session on Friday) to design a BENCH – a long seat for several persons (in this design task from two (2) to three (3) persons).*)

You may modify selected items at will, but each item **MUST** be recognizable in the final design solution. You can repeat selected items as many times as you wish. For example, if you select the cylindrical form you may use cylinders of varying sizes and propositions in your design but form must still be recognizable as a cylinder.

GROUP A



GROUP B



GROUP C

FORMAT: Your final design solution should be presented on **two 18x12 format papers**. The papers should be positioned in **landscape format**.

On the first paper (see Figure 1.) you should draw three orthographic views in a **scale** of **1-1/2"=1'-0"; one (1) plan view** and **two (2) elevations**. Briefly describe your design solution on the bottom right corner of the paper (printed). On the second paper (see Figure 2), you should draw **two (2) perspective views** in two different positions. Provide notes specifying all materials for your final design solution. All drawings should be rendered in color by hand.

UPON COMPLETION: Place your drawings (two 18x12 format papers) and instruction sheet back in the envelope. The envelope should be signed, dated and submitted to the instructor.

DURATION: The duration of the session is **three (3) hours**. You are free to submit your completed work at anytime. After the submission, you are not allowed to return.

NOTE: During the session, you are not allowed to talk to other participants nor to the instructor regarding the design task or solution. Remember, this is a "design-on-your-own" assignment.

Figure1.

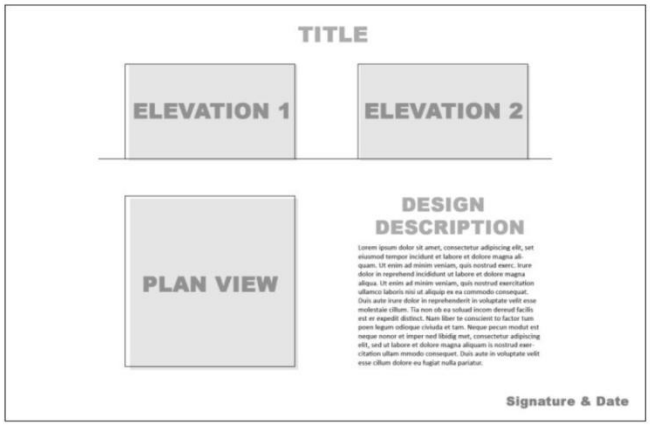
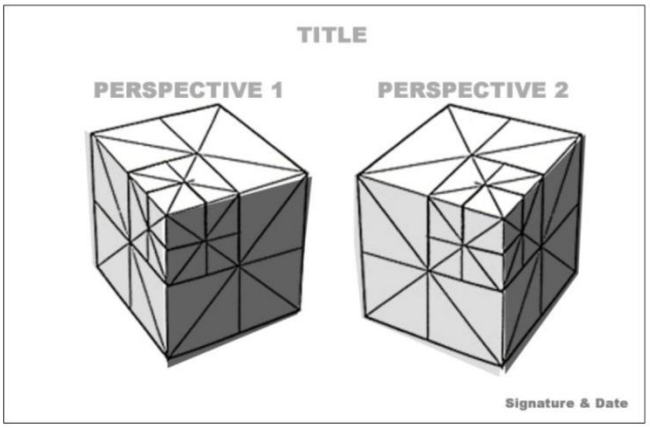


Figure 2.



YOUR PARTICIPATION IN THIS EXPERIMENT IS GREATLY APPRECIATED. THANK YOU.

Appendix B – Cover letter to judges using Consensual Assessment Technique (CAT)

02-2010

Dear Judge,

Thank you for agreeing to assist me with this evaluation. This activity is a component of my Master's thesis. I am interested in examining the effects of music on creativity during the design process by measuring the differences in levels of creativity of the final design product of interior design students.

You will be evaluating furniture design solutions, which emerged from a controlled design experiment. The solutions were created by students enrolled in their fourth year of the Interior Design Program, at Washington State University. The design ideas were developed during the experiment which included **two 3-hour design sessions** (two days). Each student produced two design solutions: one design was produced ***with music stimuli*** in one session, and the other design was produced ***without music stimuli*** in the other session.

I am asking you to evaluate several dimensions of the final designs (***creativity, novelty, application of materials, aesthetic appeal, placement of shapes, functionality, technical quality, neatness, evident effort, expression***) using a method called the Consensual Assessment Technique. This method was developed in support of research suggesting that creativity can be effectively evaluated using a group of raters who have had some formal training in the area which is to be evaluated.

An important component of this technique is that each rater works independently, and does not confer with another rater on scoring. Please, review each design carefully before scoring.

In this experiment I am primarily interested in looking for differences between the designs produced by a student participant during their first (A) and their second (B) session. Therefore, you should rate one student at a time (both their sessions) and complete/rate one dimension at a time as you evaluate each student. For instance, you should rate two designs **A** (first session) against **B** (second session), under student number **D1**. Continue by evaluating the next student number in the same manner. Also, when you are rating, please consider one dimension at a time.

The definitions of the dimensions you are assessing are provided on the judge scoring sheet. Please when you are done with the evaluation leave all scoring material with Kristie Clark in the office.

You will have from **Tuesday 2/23/2010** to **Friday 2/26/2010** to complete the evaluation. If you have questions or concerns regarding the evaluation, please feel free to contact me.

Thank you for your assistance and taking the time to evaluate the design solutions.

Sincerely,
Pedja Maksic

pedja.maksic@yahoo.com
503.360.8303

Appendix C – Rating sheet used for Consensual Assessment Technique

Washington State University, Interdisciplinary Design Institute

JUDGE SCORE SHEET

02-2010

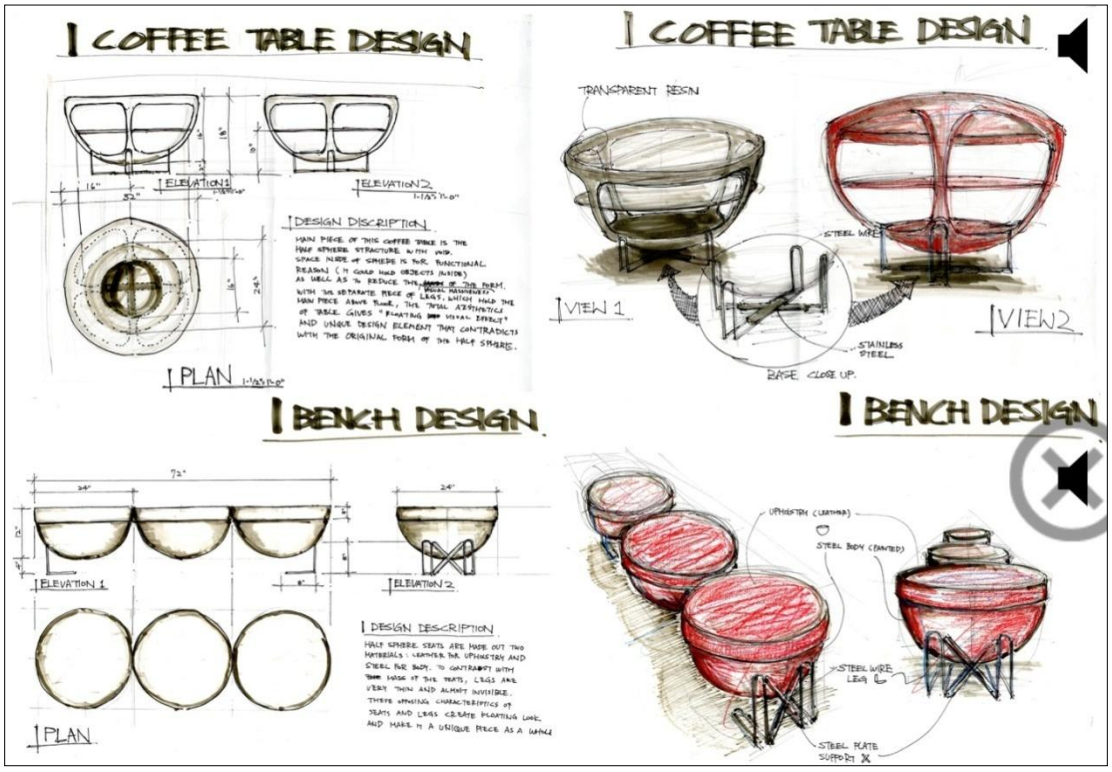
JUDGE NAME	

Student Number	

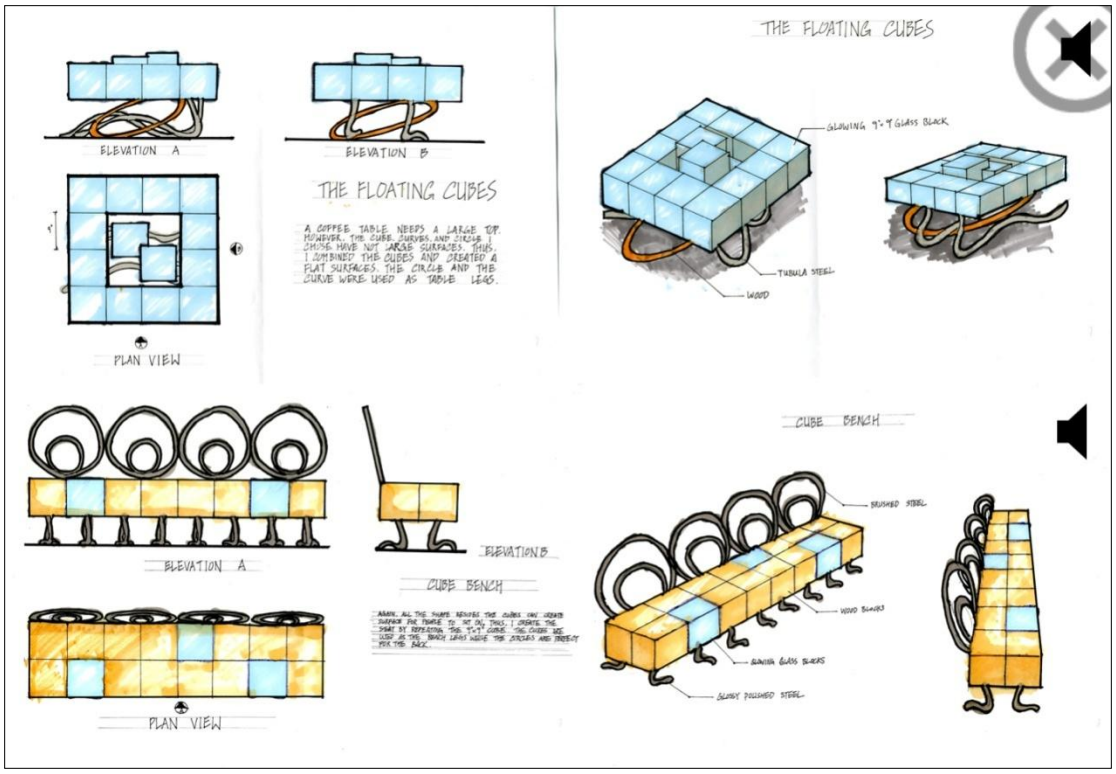
Please rate each dimension by checking the boxes with 1 being low, 4 being mid and 7 being high. Thank you.		1	4	7
Creativity - using your own subjective definition of creativity, the degree to which the design expresses original or innovative thinking.	A			
	B			
Novel idea – the degree to which the design is unusual or has unexpected components.	A			
	B			
Creative application of materials – the degree to which the design shows creative usage of materials.	A			
	B			
Overall aesthetic appeal - in general, the degree to which the design is aesthetically appealing.	A			
	B			
Pleasing placement of shapes - the degree to which there is a pleasing placement of shapes in the design.	A			
	B			
Functionality – the degree to which the design reflects its use, convenience and utility.	A			
	B			
Technical quality – the degree to which drawings and images indicate achievement of skill and craft.	A			
	B			
Neatness – the degree to which neatness is shown in the design.	A			
	B			
Effort evident – the amount of effort that is evident in the design, according to your subjective overall impressions.	A			
	B			
Expression - the degree to which the design conveys a literal, symbolic, or emotional meaning to a judge.	A			
	B			

Appendix D – Examples of the design solutions created by students (D4&D5)

D4

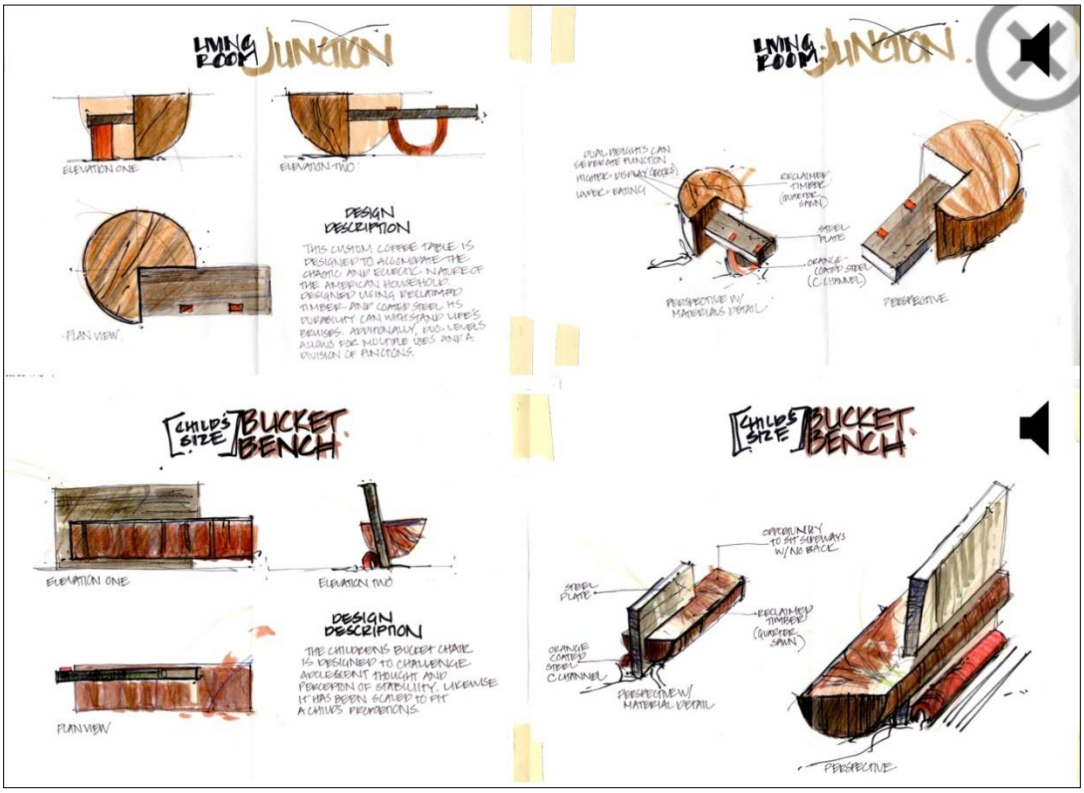


D5

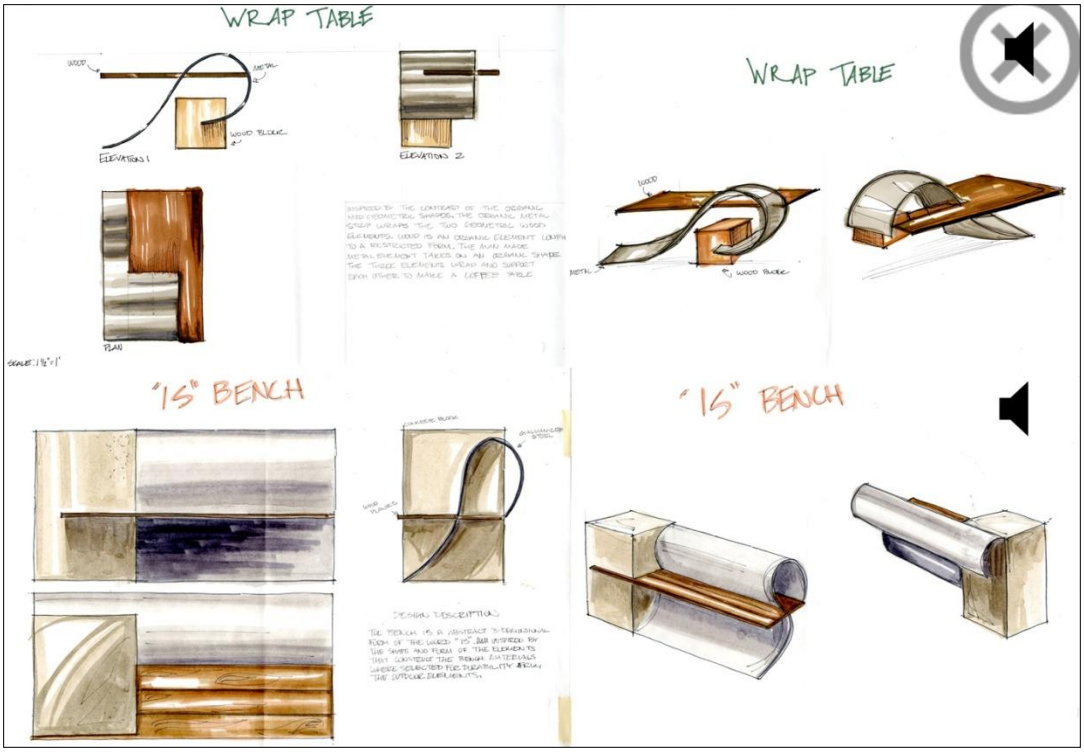


Appendix E – Examples of the design solutions created by students (D8&D13)

D8

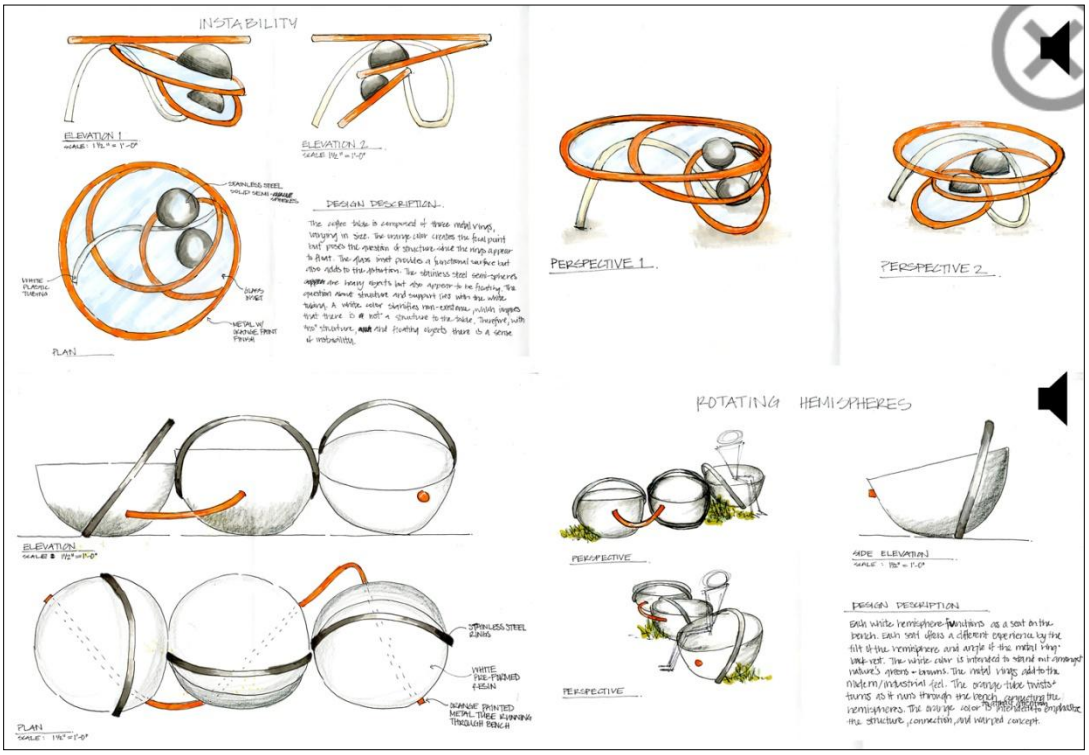


D13



Appendix F – Examples of the design solutions created by students (D14&D17)

D14



D17