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ASSESSMENT AND INTERVENTIONS"



**Ph.D. THESIS SUMMARY**

**COGNITIVE, MOTIVATIONAL AND  
PERSONALITY CORRELATES OF  
CREATIVITY IN ARCHITECTURE**

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**Key words:** design creativity, creative self-efficacy, creative identity, creative potential, creative performance, analogical reasoning, extrinsic motivation, intrinsic motivation, HEXACO model of personality

# **CHAPTER I.**

## **THEORETICAL SUBSTANTIATION OF STUDIES**

### **1.1 Introduction and Research Questions. Basic Concepts.**

Creativity is investigated in several domains, not only in psychology, but also in various domains of science, such as art (ex.: White, 2008; Hope, 2010), sociology (ex.: André and Abreu, 2009), business, economics (ex.: Ward, 2004; Heinze, Shapira, Rogers and Senker, 2009; Busch, 2008, Burgess, 2008a, Burgess, 2008b, Zhou and George, 2001), in neuroscience (ex.: Jung et. al., 2010), and many other fields of different sciences.

This thesis focuses on creativity in architecture, especially on design creativity, which is a key component of the planning process.

Design and architectural design differ from other tasks, as problem solving involves both internal and external information (Demirkan and Hasirci, 2009). According to the definition of Cropley (2006) a product must be not only novel or surprising, but at the same time convergent with the need and purpose for which it was designed.

The present studies, researches will analyse creativity from several points of view, focusing on the self-perception of creativity and creative performance in the field of architecture. This thesis contains a more detailed investigation of the predictors of creativity, such as analogical reasoning, intrinsic motivation, extrinsic motivation and personality traits.

### **1.2 Synthetic Evaluation of Scientific Literature for Creativity**

#### **1.2.1 Definitions and Evaluation Methods for Creativity**

Defining and measuring creativity is very difficult due to the complexity of the concept, and scientific literature brings this topic into discussion frequently (Feist, 1998; Pope, 2005; Runco, 2007). The definitions of creativity can be divided into four groups, depending on the object of creativity: a process, a product, an environmental factor or a person (Runco, 2007).

The traditional instrument used over the years to determine the level of creativity was the inventory of "Torrance Tests of Creative Thinking" developed by Paul Torrance in 1966 (Kim, 2006). The measuring method called Consensual Assessment Technique is



based on the idea that the optimal way of determining the level of creativity assesses the degree of creativity in products generated by third parties (Miller, 2007).

Batey (2012) proposed a model of 4\*4\*3 for measuring creativity describing three axes along which creativity assessment tools can be categorized: level or individual (e.g. individual, group), aspects (e.g. feature, product, process) and the measurement (type) used in the approach (e.g. self-perceived, objective).

### **1.2.2 Comparative Analysis of the Concepts of Creativity, Talent, Giftedness and Innovation**

Giftedness includes creativity as its central component. In Gagné's theory (2010), giftedness, talent and creativity are treated differently. According to the "Triadic Model of Giftedness" talent stands out when the following components overlap: skills above average, creativity and involvement in the assignment (Renzulli, 2002, 2003).

Sternberg's (2003) Model of Giftedness (WICS) conceptualizes giftedness as a synthesis of wisdom, intelligence and creativity.

Creativity is not synonymous with innovation. Amabile (2000) defines innovation as a successful implementation of creative ideas within an organization. This definition distinguishes between generating creative ideas and implementing them in organizations.

The genius is another construct with an extraordinary creative capacity, leading to the creation of highly original products and uncovering new ways in its field of activity (p. 15, Roco, 2004).

### **1.2.3 Creativity and Intelligence**

Over the years several studies have analysed the connection between creativity and intelligence. According to certain theories, intelligence implies creativity (e.g. Guilford, 1967, see Mező and Mező, 2003) others showcase a reversed relation, with intelligence being a subset of creativity (e.g. Stenberg and Lubart, 1995) and there is existing research that proves the independence of both factors (e.g. Getzels and Jackson, 1962, Wallach and Kogan, 1965, see Sternberg & O'Hara, 2009). According to contemporary studies creativity as a variable is linked by a medium level of intelligence (see Batey & Furnham, 2006).

#### ***Threshold theory***

Threshold theory implies a curvilinear relationship between intelligence and creative abilities, i.e. a positive correlation between these variables but only in the case of an IQ

lower than 120. Over this mark the correlation becomes minimal or insignificant (Gralewski, Weremczuk and Karwowski, 2012).

There are hundreds of studies that validate this theory (e.g. Jauk, Benedek, Dunst, & Neubauer, 2013; Karwowski, & Gralewski, 2013; Gralewski, Weremczuk, & Karwowski, 2012; Cho, Nijenhuis, van Vianen, Kim, & Lee, 2010; Fuchs-Beauchamp, Karnes & Johnson, 1993) and there are scientists who arrived to the conclusion that this hypothesis is incorrect (e.g. Kim, 2005; Runco, Millar, Acar, & Cramond, 2010; Preckel, Holling, & Wiese, 2006; Sligh, Connors, & Roskos-Ewoldsen, 2005).

#### **1.2.4 Individual Differences in Creativity**

While examining creativity it has been attempted to obtain answers to questions that address individual differences, personal susceptibilities that determine creativity (e.g. Simonton, 2000; Choi, 2004; Furnham & Niderstrom, 2010) or contextual factors which promote individual and group creativity (e.g. Hennesy 1995; Amabile & Conti, 1997; Simonton, 2000; Howard-Jones, 2002; Niu & Sternberg, 2003; Furnham & Niderstrom, 2010).

Researches done in the field of creativity have also assessed gender differences. In the great majority of studies no significant differences emerged, however in every instance that this difference occurred, most researchers arrived to the conclusion that female subjects tend to have a greater performance rate in comparison to male subjects (Baer, 1999a).

#### **1.2.5 Relevant Theories of Creativity**

In the scientific literature of the field several models, theories of creativity have emerged that describe this phenomenon from various points of view. Some of the more important and fairly new theories, approaches based on research done by Kozbelt, Beghetto and Runco (2010) are: Theories of Development, Psychometric Theories, Economic Theories, Stages of the Process and Componential Models, Cognitive Theories, Theories based on the solving of tasks and expertise, Evolutionary Theory (Darwinian), Typological theories and System Theories.

##### **1.2.5.1 The factor theory (J. P. Guilford)**

According to Guilford (1950) the topic of creativity has been neglected in psychology. The author asked two important questions: 1. How can we assess or recognize creativity in children? 2. How could a creative personality be developed?

The analysis of creativity is part of Guilford's (SOI) model, emphasizing the structure of intelligence (1968, see Kozbelt, Beghetto and Runco, 2010).

#### **1.2.5.2 The Social Psychology of Creativity. The Componential Model of Creativity (T. Amabile)**

Among the first componential models we need to mention Teresa Amabile's theory (Amabile, 1985) elaborated in the eighties. According to this model creativity is a type of behaviour resulting from the connection of the following elements: industry-specific skills, creative skills and motivation relevant to the task. According to the theory the creative process is well defined and sequential. These sequences are as follows: the presentation of the task, priming, response generation, validation and the final result (Makel & Plucker, 2008).

#### **1.2.5.3 Systems Model of Creativity (M. Csikszentmihályi)**

According to Csikszentmihályi's approach (1999), creativity is more like a cultural and/or social phenomenon rather than a mental process. In his view creativity is not an individual product, but more like something what society would deem as creative. This means that a product considered creative by a certain culture might be seen as completely irrelevant from this point of view by other cultures.

#### **1.2.5.4 Investment theory of Creativity (R. J. Sternberg and T. Lubart)**

Investment theory, formulated by Sternberg and Lubart (1995, 1996), is based on the idea that, creative people are willing and able to buy at a low and sell at a high price when it comes to ideas. This is a componential model, because it stipulates that creativity requires the confluence of six distinct resources: intellectual skills, knowledge, thinking styles, personality, motivation and environment.

#### **1.2.5.5 Theory of Cognitive Components (M. Runco and I. Chand)**

The last componential model is addressing the issue of cognitive components. One of the latest models is that of Runco and Chand (1995). According to this model creative thinking has two basic levels: the first level contains the cognitive operations that are interacting, while the second level comprises the relationship between motivation and knowledge, which in most cases depends on factors situated at the first level.

### **1.2.6 Creativity or Creativities? General or Specific Creativity**

Studies on this subject are contradictory and results are ambiguous. There is research that states the specific nature of creativity (e.g. Tsai, 2014; Silvia, Kaufman, and Pretz, 2009 Han and Marvin, 2002 Baer, 1998 Plucker, 1998) and studies that emphasize the general character of creativity (e.g. Plucker and Beghetto 2004; Hong, Milgram and Gorsky, 1995). These disagreements have occurred due to vagueness in the definition of the phenomenon and the word "creative" (Hong, 2014).

### **1.2.7 Creativity in Architecture. Basic Principles of the Psychological Approach of Creativity in Planning and Design**

Human beings are able to create, and this ability is expressed in various fields such as art, technology and science (Radel, Davranche, Fournier and Dietrich, 2015). Creativity is a key element in various areas of design (Cross, 1997; Christiaans, 2002; Casakin and Kreitler, 2011). Over the years there have been several models to describe or define the process (see Sternberg and Davidson, 1999).

#### **1.2.7.1 Methods of creativity assessment in planning and design**

As four main categories can be identified when defining creativity, its assessment is also performed along four broad categories: the process of creativity, personality and related behavioural components, the characteristics of creative product as well as the attributes of the stimulating environment (Runco, 2007).

In design empirical studies have investigated creativity using the product as key element, as the result of the creative process (e.g. Christiaans and Venselaar, 2005; Demirkan and Hasirci, 2009). The level of creativity in architecture was measured with self-perceptive methods (e.g. Casakin and Kreitler, 2008; Kreitler and Casakin, 2009a, b, 2010). In addition, studies of creativity analysis in design use as well case studies as research method (e.g. Candy and Edmonds, 1996; Cross, 2002).

## **1.3 Relevance of Current Research**

Creativity has been recognized as one of the most important contributing factors to individual performance in various activated domains, therefore researchers and practitioners dedicate a lot of attention to creative performance (Shalley, Zhou, and Oldham, 2004).

In the current economic climate the capacity to generate new ideas and products that are at the same time valuable, useful and novel is an essential requirement in the field of design (Pisano and Shih, 2009).

This phenomenon can be found in everyday life, but also in industrial activity. Within these so called creative industries we find architecture next to publicity, film and video, software etc. (Fryer, 2012). The design process in architecture is based on the level of creativity and therefore it is appreciated to its highest levels (Kowaltowski, Bianchi and de Paiva, 2010).

Because of the specific characteristics of creativity this paper focuses on creativity in the field of architecture and more specifically creativity in design as it becomes visible in the process of planning.

One of the most important aspects of this paper is obtaining a certain type of data that would permit the analysis of psychological correlations of creativity and the creation of a psychological profile of creative individuals. These profiles would be relevant in multiple ways. Firstly when it comes to theoretical knowledge we would be able to add greatly to the existing creative correlations in the current specialty literature. Secondly the patterns of correlations of creativity in design would contribute to a series of practical applications in a field rarely studied but at the same time greatly influenced by the fact that the resulting products need to be the result of a highly creative process starting from the most basic level.

Based on the above, our objective in evaluating the motivational and personality profile of creative individuals could be the foundation of a system aimed at raising the levels of creativity.

Bringing the motivational aspects in creativity to awareness would be of great value for educational professionals. As a result they would be able to better evaluate levels of creativity and encourage the entire process of planning and design. As a bonus these studies would present professionals with the opportunity to describe at least parts of the creative profile of individuals. Last but not least, this research showcases the cultural side dictated by the creative side of architecture. These profiles have been investigated based on differences dependent of specific cultural climates.

## **CHAPTER II. RESEARCH OBJECTIVES AND GENERAL METHODOLOGY**

### **2.1. Objectives of the Thesis**

#### **2.1.1 Theoretical Objectives**

The general objectives of the thesis follow the investigation of the predicting factors of creativity in design in the case of architects at a cognitive and non-cognitive level. On a theoretical level our thesis is aimed at the analysis of creativity and its predicting factors such as: analogical reasoning, motivational characteristics and personality traits. Our aim is to contribute to a theoretical model that represents the synergy of potential influencing factors of creativity.

Because of the specific character of creativity our thesis is focused on creativity in architecture. Creativity is addressed based on multiple points of view such as: self-reported creative self-efficacy, creative identity, creative potential and creative performance.

The first direction of the thesis is to follow up on the analysis of the influence of analogic reasoning on the process of generating creative products. As a first step the thesis showcases a quantitative and qualitative exploration of the relevant data from previous studies that explored the relation between analogical reasoning and creativity. The second direction is aimed at the analogical reasoning through various examples gained before the design process. The investigation comprises the testing of the influence of various types of examples received before generating a creative product based on its creative characteristics. Further on, this research focuses on the effect of analogic distance on the process of generating innovative products. In contrast to the previous objective in the next study analogical reasoning is being operationalized via solving geometric analogic tasks.

Furthermore, in this thesis we aim to explore the possible intercultural differences in the creative auto efficacy and the creative potential. Among the objectives linked to intercultural differences our goal is not only to establish these differences, but also to verify the connection between motivation and creative auto efficacy in the domain of architecture, as well as to analyse the personality structure of the architect student with the use of the HEXACO model.

At the same time, we intend to investigate the relationship between creativity and motivation or personality traits, as well as to test the influence of creative potential and creative self-efficacy on these relations.

### **2.1.2 Methodological Objectives**

The methodological aim of the thesis is to enrich the existing methodological tools used in determining the level of creativity via self-assessment and professional evaluation. Our aim is to develop an assessment scale of a product in the field of architecture. Based on this scale the development of a web application that would offer students an instant feedback on their projects will be possible. This would be a visual type of assessment based on the average scores received at each separate factor. Based on these values the students will receive a diagram that will point out weaknesses, strong points and averages in their respective projects.

Moreover, we intend to examine the validity and reliability of the self-reported assessment of creativity, which includes three dimensions of creativity: creative self-efficacy, creative identity and creative behaviour.

Testing the psychometric characteristic of the toolset developed for the assessment of analogical thinking is also a methodological objective.

### **2.1.3 Practical Objectives**

The practical objective of the thesis is the development of a creativity assessment program. The program offers the user a valuable feedback on a project but at the same time an opportunity to compare results. Furthermore, based on the acquired data we intend to make some suggestions regarding the development of creativity and its predicting factors.

## **CHAPTER III.**

### **VALIDATION OF INSTRUMENTS USED IN THE ASSESSMENT OF CREATIVITY**

#### **3.1 Study I – Validation Study of the Multifactorial Assessment Scale for the Creative Product and Self-reported Creativity Scale**

##### **3.1.1 Theoretical Substantiation**

There are several assessment types for assessing the level of creativity: experimental, biographic, contextual, computational, and last but not least psychometrical instruments (Mayer, 1999).

In the field of design, creativity assessment based on products was frequently used. Besemer and Treffinger (1981, apud. Besemer, 1998) developed the theory of Creative Product Analysis Matrix in order to measure creativity in a more objective way, using criteria of assessment based on the creative product.

##### **3.1.2 Objectives**

The main objective of the study is to obtain an overview of the validity of instruments which measure the level of creativity (Multifactorial Assessment Scale for the Creative Product and self-reported Creativity Scale).

#### **Study Ia – Validation of the Multifactorial Assessment Scale for the Creative Product**

##### **3.1.3 Method**

###### **3.1.3.1 Participants**

Our sample consisted of 90 architecture students (N=90), all in their first year of study. Their mean age was 19.71 years (SD=1.02). Gender distribution was equal, 50 % males and 50% females. The assessment was carried out by two teachers with 6 and respectively 4 years of experience in this field.

###### **3.1.3.2 Instruments**

The *Multifactorial Assessment Scale for the Creative Product (MASCP)* was developed by psychologists and professional architects based on specialty literature. (Besemer, 1998; Christiaans, 2002; Demirkan & Afacan, 2012; Demirkan & Hasirci, 2009; Hasirci & Demirkan, 2007, 2003; Horn & Salvendy, 2006a, 2006b; O'Quin & Besemer, 2006, 1999; White & Smith, 2001). The preliminary scale consists of 34 items and was



coded on a scale from 1 to 7, where the higher score implies a high level of creativity. The items are bipolar adjectives. The scale includes five factors: Novelty, Resolution, Elaboration and Synthesis, Aesthetics and Functionality and Applicability.

*Consensual Assessment Technique (CAT)* (Hennessey and Amabile, 1999) was used in order to measure the overall score of creativity with a Likert scale from 1 to 5. This is an approach, which evaluates creativity based on the artefacts.

### 3.1.3.3 Procedure

The design of the study was correlational, where our objectives were to analyse the aspect validity, internal consistency and concurrent validity of this scale. As a first step we have used the scientific literature in order to collect pairs of adjectives. The aspect validity of the scale was tested in a pilot study. The instrument was restructured based on the arguments of psychologists and architects. In the main study participants had a task from their curriculum. The theme of this project was to design a temporary pavilion. These products were assessed by two architects.

## 3.1.4 Results

### Aspect validity

34 bipolar adjectives were selected from the specialty literature. Teachers were interviewed after they had evaluated the projects of the students. The initial scale was revised based on their arguments and opinions.

### Reliability analysis

Internal consistency (Cronbach  $\alpha$ ) was assessed in order to evaluate the reliability of MASCP. This value shows an excellent consistency,  $\alpha = .96$  (N=90) for 24 items. We calculated the Alpha Cronbach index separately for the subscales. These results are presented in Table 1.

**Table 1**

*Coefficients of Alpha Cronbach for the subscales of MASCP*

No.	Subscales	Cronbach Alpha $\alpha$	Number of items
1	<b>Novelty</b>	.94	3
2	<b>Resolution</b>	.82	5
3	<b>Elaboration and synthesis</b>	.92	5
4	<b>Aesthetics</b>	.96	5
5	<b>Functionality and applicability</b>	.78	6

### Convergent Validity

We have computed Pearson product-moment correlations between the scores of MASCP and of CAT in order to establish the convergent validity. Pearson coefficient was significant and shows a strong positive relation between these scores ( $r(88) = .81, p < .01$ ).

### Inter-rater fidelity

Statistical analyses were used to test the inter-rater fidelity. Due to the fact that scores are quantitative values, we have calculated the association between the two raters, on the overall evaluation and on each subscale as well. The results are presented in Table 2.

**Table 2**

*Intercorrelations between the scores of MASCP given by the two raters*

Assesso 2	Creative performance (overall)	Novelty	Resolution	Elaboration and Synthesis	Aesthetics	Functionality and applicability
Assesso 1						
Creative performance (overall)	<b>.68**</b>	.53**	.68**	.60**	.59**	.59**
Novelty	.49**	<b>.55**</b>	.47**	.41**	.44**	.30**
Resolution	.59**	.43**	<b>.61**</b>	.53**	.51**	.55**
Elaboration and Synthesis	.67**	.49**	.66**	<b>.61**</b>	.59**	.59**
Aesthetics	.61**	.46**	.60**	.53**	<b>.56**</b>	.53**
Functionality and applicability	.50**	.32**	.54**	.45**	.41**	<b>.52**</b>

\*\* $p < .01$  \* $p < .05$

### **3.1.5 Discussion and Conclusion**

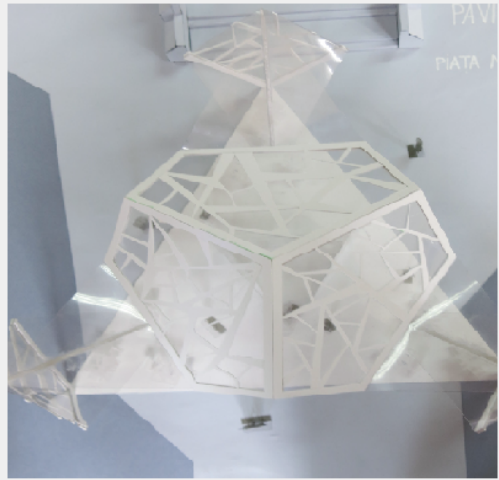
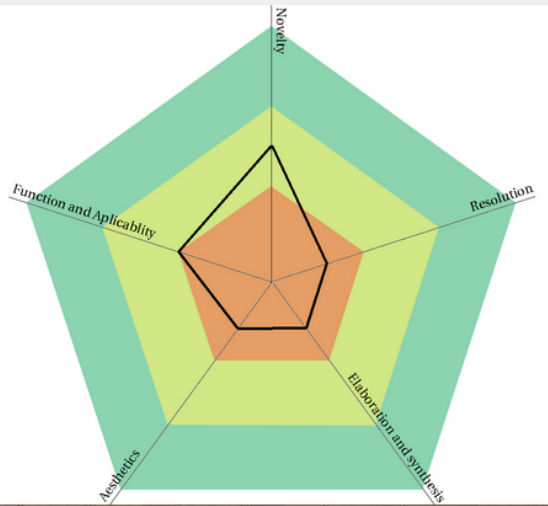
The scale was revised after the aspect validity test and based on the other statistical results. The final version of it contains 24 items, grouped in five subscales: Novelty, Resolution, Elaboration and Synthesis, Aesthetics and Functionality as well as Applicability.

Due to the good psychometrical characteristics of the scale a computerized program was developed based on it. This web application gives users an evaluation of their products. It contains a visual form of feedback arranged by the scores on the subscales. Figure 1 shows examples of two kinds of feedback, the first one for a project of a low level of creativity and the other one of a high level. As you can see from those figures, the more the model extends to the green section, the higher the level of creativity.

Model a.)

Home Back

Feedback



Model b.)

Home Back

Feedback

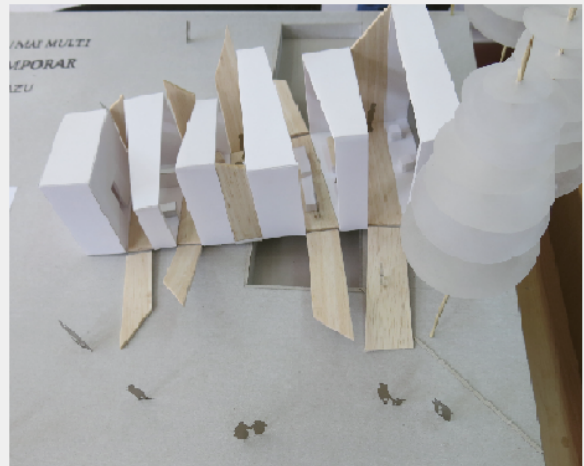
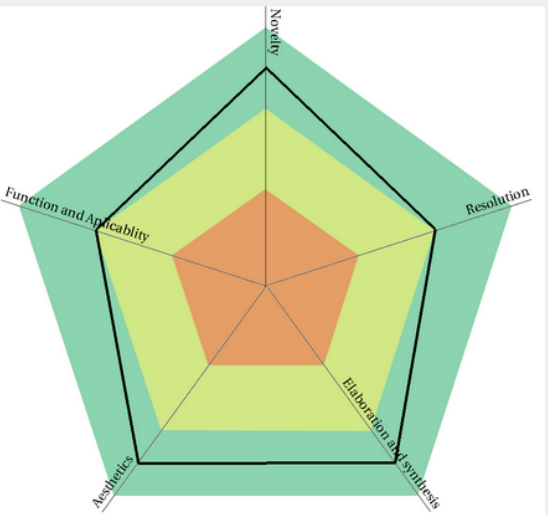


Figure 1 The pentagon model of feedback for products, based on the MASCP scores (model a.) low level of creativity, model b.) high level of creativity)

## **Study Ib.- Validation of the Self-reported Creativity Scale**

### **3.1.6 Method**

#### **3.1.6.1 Participants**

In this study the sample contains 151 ( $N=151$ ) students from Technical University, Cluj-Napoca, with ages between 19 and 27 years ( $M= 20.38$ ,  $SD= 1.41$ ). Of the total number of participants, 45.0 % ( $N=68$ ) were male and 55.0% ( $N=83$ ) female, 60.9 % ( $N= 92$ ) were in their first year of study, 27.2% ( $N= 41$ ) were in their second year and 11.9% ( $N= 18$ ) in their third year.

#### **3.1.6.2 Instruments**

For the *Self-reported Creativity Scale* (CS) two existing scales were combined to identify the three main approaches of self-perceived creativity: creative self-efficacy, creative identity and creative behaviour. The complete scale contains 20 items, the first 20 of them were retrieved from Karwowski (2012) and Karwowski, Lebuda and Wiśniewska (in press), and the other 11 from Yu's (2013) study.

#### **3.1.6.3 Procedure**

As a first step we have translated the English version of the scale. It was completed by two psychologists in order to assess its aspect validity. As far as construct validity is concerned, we intend to analyse the factorial structure of the scale with the method of confirmatory factor analysis by the IBM Amos SPSS (20.0), taking into account the values of model fit indicators (model-fit).

### **3.1.7 Results**

#### Aspect validity

It was tested by translation and re-translation, and by comparison of the two English versions. The first version was analysed and completed by two psychologists. They have identified the three main targeted constructs: creative self-efficacy, creative identity and creative behaviour.

#### Reliability and construct validity of the scale

Before the factorial analysis we tested the internal consistency of the original scale. Alpha Cronbach coefficient was higher after the elimination of the 10<sup>th</sup> item,  $\alpha=.91$ , which shows an excellent internal consistency.

We expected to get three factors from the two compiled questionnaires. To investigate this assumption, CFA (confirmatory factor analysis) was used. Coefficients of the model suggest a good fit (CFI = .88, GFI= .99 RMSEA= .074 (CI 90% = 0.061 - 0.086)). The value of the ratio  $\chi^2/df$  ( $\chi^2$  relative) is 1,98, which is considered an acceptable coefficient of the model fit, because it is below the acceptable maximum value of 5 ( $\chi^2$  (149) = 295.9). The Alpha Cronbach coefficients were calculated for each subscale. Values indicate a good internal consistency,  $\alpha = .89$  for Creative self-efficacy,  $\alpha = .78$  for Creative Identity and  $\alpha = .78$  for Creative behaviour.

### **3.1.8 Discussion and Conclusion**

Construct validity was tested by confirmatory factor analysis and indexes of model-fit. The values support a proper fit to model, and include the three aspects of creativity. Also, the indices of the scale showed a good internal consistency, both the subscales and the overall scale. Our results also show that the translated instrument has good psychometric properties and thus can be used in future studies for the evaluation of self-perceived creativity.

## **CHAPTER IV. THE ROLE OF ANALOGICAL REASONING IN CREATIVE THINKING**

Analogical reasoning has an important role in creative thinking (Goel, 1997). However, this relationship is a topic of debate in the literature, some researchers claiming its positive effects (Simonton, 1999), and others emphasizing the destructive consequences of creative thinking (Çubukçu and Dündar, 2007).

Analogical distance also has an influence on the generating process of innovative products, but this is a dual one. Chan et. al. (2011) investigated the effect of variances of analogical distance, the commonness of the examples and the way they were presented on the generating process of new ideas. They showed that inter domain examples enhance the production of creative solutions. However, Althuisen and Wierenga (2014) who used the case-based reasoning theory, have found that cases with a far connection to the problem have a negative influence on the level of design creativity.

There are several articles which investigated the influence of analogical reasoning on creativity, however most of them are theoretical studies and only few contain empirical evidence.

### **4.1 Theoretical Substantiation. Relevant Theoretical Models of Analogical Reasoning**

Associative thinking is a key issue for designers because it allows reflection on issues that are apparently irrelevant. This type of thinking is based on analogical and metaphorical reasoning, thinking through visual clues etc. among other things (Casakin, 2011).

During the planning activity there may appear situations in which some ambiguous (weakly defined or unclear) problems need to be solved. At the same time, design is a process that includes creative problem solving activities, creativity being the key component (Cross, 2002; Christiaans, 2002; Casakin and Kreitler, 2011).

#### **4.1.1 The Structure-mapping Theory (D. Gentner)**

According to the structure-mapping theory, analogies are described as major structural relationships between source and target (Gentner, 1983, 2010). The latest version of this theory implies three phases of this process: determining the fit of source-target,

structural alignment and mapping. The important part of this process is the source and target structure (Gentner, 2010).

#### **4.1.2 The Model of Case-based Reasoning (CBR) (J. L. Kolonder)**

The case-based reasoning theory (CBR) is a form of analogical reasoning and was elaborated by J. L. Kolonder (1997, 2002). According to this theory there are four criteria which constitute the basis in the elaboration of new analogies by reusing information from memory: 1. volume and quality of expertise represented by "cases" in long-term memory; 2. ability to understand new problems by integrating "cases"; 3. adaptations of previously solved cases to new problems; 4. evaluation of strategies and their reuse in targeted problem solving process (Kolonder, 1997).

#### **4.1.3 The Model of Near and Far Transfer in Analogy (S. M. Barnett and S. J. Ceci)**

Barnett and Ceci (2002) have elaborated a taxonomy built on two main factors: the content and context which imply the reuse of knowledge acquired during the solving of new problems. Based on these two the authors differentiate between near transfer (using knowledge from the same field) and far transfer (knowledge which is used from other fields).

### **4.2 Analogical Reasoning in the Field of Architecture and Design**

Analogical reasoning appears in the case of clues in the form of words, images, sentences or a combination of these (Smith, Ward and Schumacher, 1993; Schwert, 2007). Stimuli that appear in the first phase of the design process can become sources for analogies. These can operate as starting points for a designer in the problem solving process (Casakin and van Timmeren, 2014). Suggestions and/or clues facilitate the access to relevant information, thus creating a source of analogies (Dahl and Moreau, 2002).

In analogical reasoning investigations clues can be classified according to their quality and quantity. Some studies compared only situations in which clues were given or omitted (ex.: Dahl and Moreau, 2002), but others have also manipulated the quantity of the given clues (ex.: Goldschmidt and Smolkov, 2006).

Another group of researcher the emphasis was on the quality of cases or clues (ex.: Chan, Fu, Schunn, Cagan, Wood and Kotovsky, 2011; Green, Cohen, Kim and Gray, 2012).

## **4.3 Study II – A Quantitative Meta-Analysis of the Effects of Analogical Reasoning on Generating Creative Products**

### **4.3.1 Objectives**

Throughout this meta-analysis our main purpose was to investigate the relation between analogical thinking and creativity in different fields of design. Furthermore, the main goal was to conduct a global quantitative meta-analysis regarding this relation.

We aimed:

1. to examine the effect of analogical thinking on the process of generating creative products
2. to provide a global effect size of the effects of analogical thinking on creativity, using visual cues
3. to identify variables that may moderate this relation

### **4.3.2 Method**

#### **4.3.2.1 Procedure**

##### Selection of studies

In our meta-analysis we included studies that report quantitative data regarding the effects of analogical reasoning on creativity or creative products. The data collection process consisted of a systematic search on PsycINFO, Ebsco and IEEEExplore using the following key terms: *analogical reasoning*, *analogy*, *creativity*, *divergent thinking*, and *originality*.

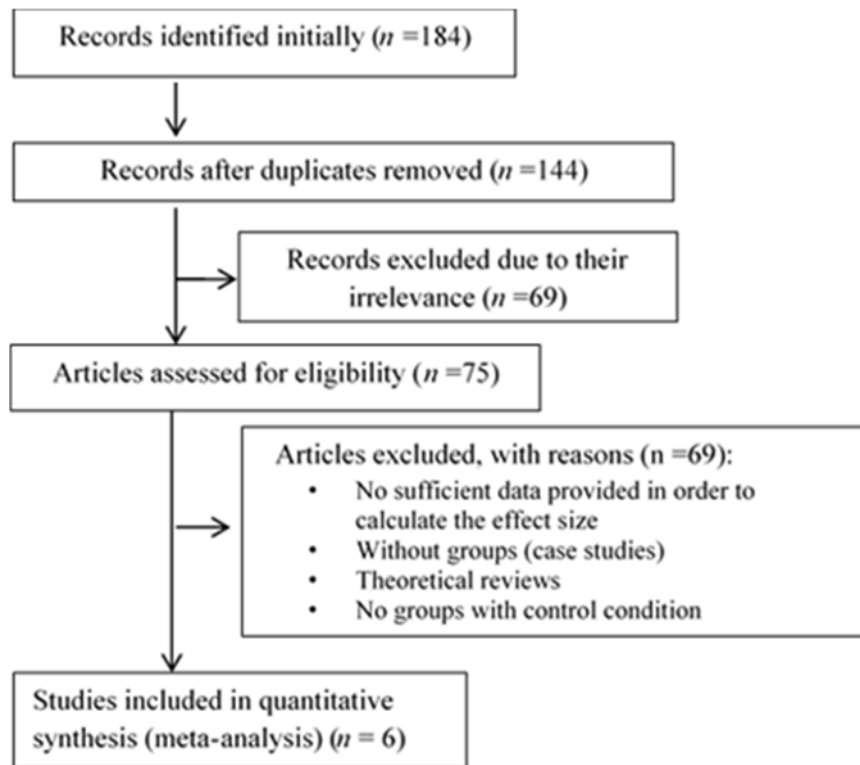
##### Inclusion criteria:

- creativity should be measured by performance
- studies should use analogical thinking quantified in clues or cases
- studies with control groups, which do not get any clues or cases
- studies must be written in English.
- studies must report quantitative data which allow us to calculate effect sizes;

We did not include case studies or included only qualitative results.

The process of selection of studies is presented in Figure 2





*Figure 2* PRISMA Flow Chart

#### 4.3.2.2 Coding of studies

We identified two groups of researches: in the first category groups were formed depending on the presence or absence of stimuli (with vs. without), in the second category researchers also manipulated the amount of cues received (high vs. low vs. no stimulus).

The dependent variable was the level of creativity and its factors. Characteristics of the studies are presented in Table 3.

After analysing the potential studies for our meta-analysis, we decided (post priori) to consider the method of stimuli presentation as a mediator variable.

We proposed to investigate whether the method of comparison (the amount of stimuli received) and measurement of analogical thinking affects the relationship between creativity and analogical thinking.

**Table 3**  
*Characteristics of the studies*

Authors	Year	N (participants)	Method of comparison	Creativity tasks	Dependent variable	No. of effect sizes
Dahl and Moreau	2002	106, undergraduate engineering students	with stimuli group vs. without stimuli group	Design task rated by 3 senior professional	originality	1
Goldschmidt and Smolkov	2006	36, architecture students	rich visual stimuli vs. modest visual stimuli vs. no specific stimuli	Two design tasks, rated by expert judges	originality	4
Çubukçu and Dündar	2007	52, architecture students	with stimuli group vs. without stimuli group	Product design task, rated by experts	originality	1
Çubukçu and Cetinthara	2010	103, architecture students	high visual clue vs. low visual clue vs. no visual clue	Two tasks from Torrance Test of Creativity Thinking- Figural	Fluency, flexibility	8
Moreno et. al.	2014	73, transactional domain experts	with case based reasoning vs. without case based reasoning	Design problem, originality calculated by a specific formula	originality	1
Althuizen and Wierenga	2014	40, marketing students	with case based reasoning vs. without case based reasoning	Design task, rated by three experts	originality	1

#### 4.3.2.1 Statistical analysis

The analyses were conducted using the Comprehensive Meta-Analysis program, version 2.0 (Borenstein, Hedges, Higgins, Rothstein & Englewood 2005). The results were evaluated on the same basis, based on the effect size measures described by Cohen (see Hunter and Schmidt, 1990). For the calculation of homogeneity Q and I<sup>2</sup> statistics were used (Borenstein et al., 2005). Also fail-safe N was calculated in order to address the publication bias (Rosenthal, 1991).

#### 4.3.3 Results

The overall effect of analogical reasoning was calculated from six studies (a total of 16 effect sizes), in which a total of 410 participants were included. Table 4 shows the effect sizes for each research.

**Table 4**  
*The effect sizes of researches*

Authors	Year	Effect sizes	95%	v
			C.I.[min;max]	
Dahl and Moreau	2002	-0.61	[-1.23;0.01]	0.10
Goldschmidt and Smolkov	2006	1.44	[0.13;2.75]	0.44
Çubukçu and Dündar	2007	0.94	[0.49;1.37]	0.05
Çubukçu and Cetinthara	2010	0.33	[-0.14;0.81]	0.05
Moreno et. al.	2014	0.28	[-0.17;0.74]	0.05
Althuizen and Wierenga	2014	0.53	[-0.09;1.16]	0.10

The received results indicate a significant but small effect of analogical thinking on creativity Cohen's  $D = 0.40$ ,  $\text{Var } D = 0.13$ ,  $p < .001$ , 95% C.I. = [0.18;0.63].

The fail-safe N for the effect of analogical reasoning was calculated. The parameter in this meta-analysis shows no strong effect because it is not higher than 40.

We found evidence for heterogeneity,  $Q(5) = 18.82$ ,  $p < .01$ ,  $I^2 = 73.44$ , so we checked the effect of moderating variable that could explain this. We found no significant moderator,  $Q(4, 1)_{\text{between}} = 0.079$ ,  $p > .05$ .

In the next step we removed the first extreme value, and as a result, the level of heterogeneity became insignificant,  $D = 0.56$ ,  $\text{Var } D = 0.01$ , C.I. = [0.32;0.80],  $Q(4) = 6.78$ ,  $p > 0.05$ ,  $I^2 = 41.02$ .

#### 4.3.4 Discussion and Conclusion

The main objective of this meta-analysis was to investigate the influence of analogical thinking on the process of generating creative products. The results indicate a significant medium effect of analogical reasoning on creativity. This effect is in concordance with results of other studies from this domain (Goel, 1997; Holyoak and Thagard, 1997; Schwert, 2007; Chan, Fu, Schunn, Cagan, Wood, and Kotovsky, 2011).

We included studies where analogical reasoning was analysed by stimuli or clues or cases presented during problem solution. Due to the fact that we have found heterogeneity in the effect sizes, we tested the moderator value of the method of comparison used in these researches. Some of the studies manipulated only the presence of the stimuli (Dahl and Moreau, 2002; Çubukçu and Dündar, 2007; Moreno et.al, 2014; Althuizen and Wierenga, 2014), Other researches included as an influential factor the quantity of the received stimuli

(Goldschmidt and Smolkov, 2006; Çubukçu and Cetintheta, 2010). The statistical analysis conducted did not find a significant moderator.

The main limitation of this research is the small number of included studies, we had a limited number of participants in the meta-analysis. This situation could be explained by the lack of studies reporting quantitative data in this domain. At the same time, another possible limit is that the studies where the manipulation referred only to the presence vs absence of stimuli did not specify the exact amount of stimuli. Therefore, further analysis should aim to control the quantity and the identification of an adequate number of analogies which can influence the creativity of participants in a positive way.

Because of differences between experts and novices in the use of analogy during problem solving in design (Casakin and Goldschmidt, 1999; Casakin, 2004, 2010; Bonnardel and Marméche, 2004; Ball, Ormerod and Morley, 2004), future studies should investigate the influence of the level of analogical reasoning and thinking on creativity based on the level of experience.

#### **4.4 Study III – Associations between Analogical Reasoning and the Level of Creativity in Design**

##### **4.4.1 Objectives and Hypothesis**

Our main purpose was to obtain an answer to the following question: "To what extent do examples influence creativity?" The methodological objective is to obtain information on the diagnostic value of the questionnaire used in studying motivation (Intrinsic Motivation Scale) and creativity (MASCPC). The practical objective of the study is to identify possible influences of examples on the level of creativity.

##### **Hypothesis:**

1. There are differences in creativity level between experimental according to the examples used
2. Differences between experimental groups are influenced by intrinsic motivation

##### **4.4.2 Method**

###### **4.4.2.1 Participants**

Our sample consists of N=75 participants, students in their third year of study. Distribution based on gender was almost equal, of the total number N= 34 (45.3%) were males and N= 41 (54.7%) were females. The mean age was 21.93 years (SD= 1.19) with a minimum of 21 years of age and a maximum of 28 years.

The distribution of students into three experimental groups was performed based on the groups established at the beginning of semester: in the group which was given intra-domain examples there were N= 25, while in the group with inter-domain examples there were N= 34 and in the group with examples from a nonspecific domain there were N= 16.

#### **4.4.2.2 Instruments**

- ❖ ***Multifactorial Assessment Scale for a Creative Product*** – The scale is a 24 item observational rating scale which contains bipolar adjectives assessed on a 7-point Likert-scale. Higher score implies a high level of creativity. The scale includes five factors: Novelty (3 items), Resolution (5 items), Elaboration and Synthesis (5 items), Aesthetics (5 items) and Functionality and Applicability (6 items).
- ❖ ***Intrinsic Motivation Inventory***. 9 items were used from the Intrinsic Motivation Inventory, developed by Deci et. al. (1994) and it contains the Enjoyment subscale. Items were coded by a scale from 1 (meaning it is not true at all) to 7 (meaning it is totally true).

#### **4.4.2.3 Procedure**

Students were given an academic task in the subject "Furniture design". They received guidance depending on which group they belonged to, regarding the type of documentation they must perform before they start to work. The final version of the projects was evaluated teachers using MASCP. IBM SPSS Statistics (20.0) was used for the statistical analysis of the data. The coefficients of effect size were calculated using the software of Soper (2015). The research design is quasi-experimental with three experimental groups. The level of creativity is the dependent variable and the types of the examples are independent variables.

### **4.4.3 Results**

As a first step we tested the reliability of the scale. All coefficients of Alpha Cronbach showed a good internal consistency: for the overall scale ( $\alpha = .96$ , 24 items), Novelty ( $\alpha = .97$ , 3 items), Resolution ( $\alpha = .92$ , 5 items), Elaboration and synthesis ( $\alpha = .95$ , 5 items), Aesthetics ( $\alpha = .96$ , 5 items) and Functionality and applicability ( $\alpha = .83$ , 6 items).

Based on the results of the statistical analysis, we did not find any significant differences between the three experimental groups, neither for the Overall Creative

performance ( $H(2, 75)=.55, p= .75$ ) nor for factors of the instrument: Novelty ( $H(2, 75)=.37, p= .82$ ), Resolution ( $H(2, 75)=.25, p= .88$ ), Elaboration and synthesis ( $H(2, 75)=.25, p= .88$ ), Aesthetics ( $H(2, 75)=.91, p= .63$ ) and Functionality and applicability ( $H(2, 75)=.26, p=.87$ ).

Furthermore, we can detect differences between these groups by analysing their means. The group with inter domain examples shows a higher mean of creativity (see Figure 3.)

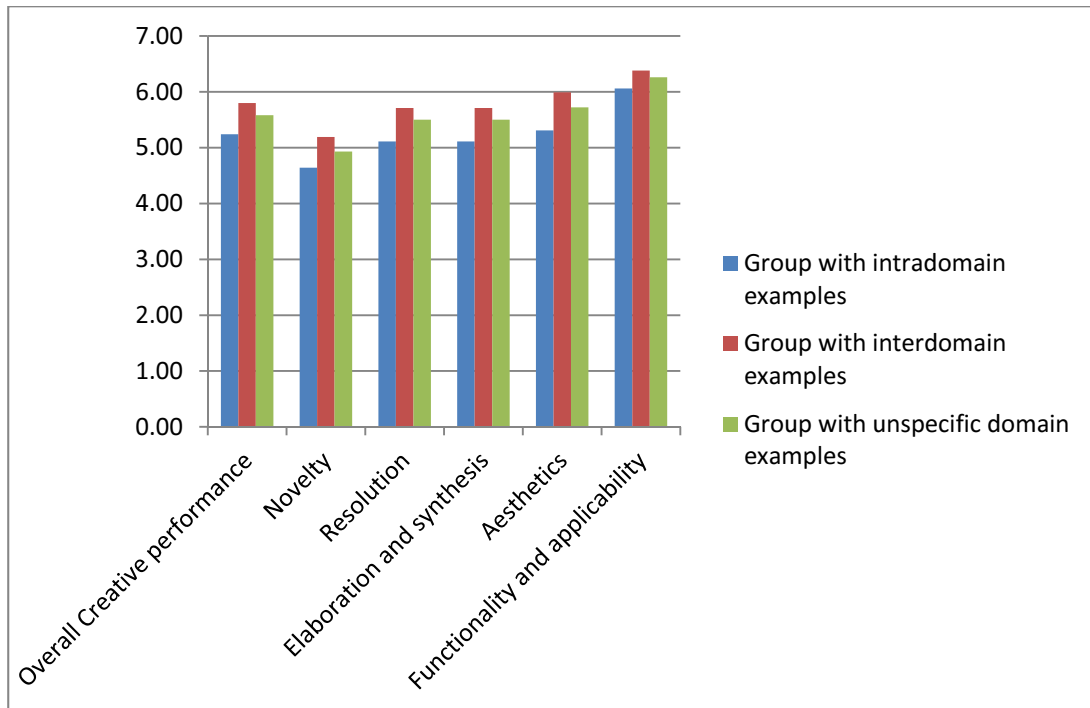


Figure 3. The level of creativity for the three experimental groups

Differences between two experimental groups (with inter domain and intra domain examples) were calculated for participants with higher intrinsic motivation because of the difference in the level of creativity among students who make high or low effort. Mann Whitney U analysis was used, after we have tested the normal distribution of data with Kolmogorov-Smirnof test. There were no significant differences between the group with intra domain and inter domain examples. Novelty ( $Mdn_{intradomain}=5.57, Mdn_{interdomain}=5.24, U=96.00, p=.33, r=.16$ ), Resolution ( $Mdn_{intradomain}=5.78, Mdn_{interdomain}=5.79, U=93.00, p=.27, r=.18$ ), Elaboration and synthesis ( $Mdn_{intradomain}=5.78, Mdn_{interdomain}=5.79, U= 93.00, p=.27, r=.18$ ), Aesthetics ( $Mdn_{intradomain}=6.01, Mdn_{interdomain}=6.07, U=95.00, p=.32, r=.17$ ), Functionality and applicability ( $Mdn_{intradomain}=6.53, Mdn_{interdomain}=6.35, U=78.00, p=.09$ ,

$r=.29$ ) and overall creative performance ( $Mdn_{intradomain}=5.93$ ,  $Mdn_{interdomain}=5.85$ ,  $U=90.50$ ,  $p=.24$ ,  $r=.20$ ).

#### **4.4.4 Discussion and Conclusion**

We analysed the differences between the three experimental groups (distributed according to the types of examples received before performing the work) in the level of creativity. Results did not show significant differences, but by visual analysis of mean creativity in each group for each factor, we can conclude that the group with inter domain examples shows a higher level of creativity for the overall creative performance, and also for factors of it. This conclusion is consistent with other research results, for example with results of Chan et. al. (2011) and Dahl and Moreau's (2002) studies.

Due to the influence of intrinsic motivation on the level of creativity (Runco and Chand, 1999; Ryan and Deci, 2000; Eisenberger and Aselage, 2009), differences were tested between groups with a high and low level of intrinsic motivation. Regarding the novelty of the products, participants who were more convinced about the value and importance of their task have performed better as compared to participants who did not feel the same way.

Moreover, the difference in the level of creativity appeared according to how hard they worked during the activity. The products of those who tried harder, were rated as newer, more aesthetic, more applicable and elaborated, i.e. more creative than the products of those students who were not intrinsically motivated to make an effort to complete the task.

### **Study IIIb – Levels of Association of Analogical Reasoning and Creative Performance**

#### **4.4.5 Objectives and Hypothesis**

Our main purpose was to investigate the relation between figural analogical thinking and creativity in design. Unlike in previous studies, in this sub-study analogical reasoning is operationalized by solving visual geometrical analogies.

##### Hypothesis:

1. There is a positive association between the level of creativity and visual analogical reasoning.

## 4.4.6 Method

### 4.4.6.1 Participants

In our study there were 93 (N=93) participants, all first year students from the Technical University of Cluj-Napoca. Distribution of gender was not equal, there were 36 male (38,7 %) and 57 female (61,3 %) students, with ages between 18 and 25 (M=19.80, SD=.91).

### 4.4.6.2 Instruments

The *Multifactorial Assessment Scale for the Creative Product* was used in order to assess the level of creativity. The scale is a 24 item observational rating scale which contains bipolar adjectives assessed on a 7-point Likert-scale. Higher score implies a high level of creativity. The scale includes five factors: Novelty (3 items), Resolution (5 items), Elaboration and Synthesis (5 items), Aesthetics (5 items) and Functionality and Applicability (6 items).

This was used to evaluate the level of creativity of students **projects**. They had to design a temporary pavilion placed in the urban setting for the purpose of organizing cultural or mundane events.

In order to assess the participants' analogical thinking we developed an instrument based on previous *analogical reasoning tasks*. This measurement contained 39 figural tasks. In each task three geometrical figures were given. Participants had to draw the fourth shape, suitable for the third one, based on the relationship identified between the first two geometrics.

### 4.4.6.3 Procedure

In this research we tested the psychometrical characteristics of our instrument. This sample included 162 architecture students. Further research used the revised version of the instrument IBM SPSS Statistics (20.0) was used for data analysis. This study has a correlational design and analyses the relation between visual analogy and level of creativity.

## 4.4.7 Results

The first part of the research contains an investigation of psychometrical characteristics of the analogical reasoning test using a pilot study. The task initially contained 39 items and it was administered on 162 architecture students in order to evaluate the instrument's level of difficulty and its reliability.



The first set of analysis investigated the difficulty level of the items. Percentages of the incorrect answers for each item were calculated. Based on this analysis, items with less than 10.5 % were excluded, which means that 10.5% of this sample answered the task incorrectly. One more item was eliminated, which had the highest percentage of incorrect answers (96.3 %).

The next step of the data processing included the assessment of the reliability value of this instrument. Cronbach's Alpha was computed on the remaining items (32 items) in order to evaluate the internal consistency of the analogical reasoning task. Taking into account the inter-item correlations, items that correlated least with other items in the test were deleted. Finally, we have computed the Cronbach's Alpha coefficient on 23 items,  $\alpha = .72$ , which is between acceptable and good interval.

We have calculated the coefficients of Alpha Cronbach of the Multifactorial Assessment Scale for the Creative Product in order to establish its internal consistency. This instrument has five factors with good and excellent internal consistency: Novelty ( $\alpha = .95$ ), Resolution ( $\alpha = .83$ ), Elaboration and Synthesis ( $\alpha = .92$ ), Aesthetics and Functionality ( $\alpha = .95$ ) and Applicability ( $\alpha = .77$ ).

After that, the relation between analogical reasoning and creativity was tested. In order to establish the linear connection between these two constructs we have conducted correlation analyses. There was no significant ( $p > .05$ ) correlation between creativity scores and analogical reasoning (coefficients have values between .008 and .072).

Participants were grouped depending on creativity scores and scores on the subscales of creativity measure: high (from  $M+SD$  to Max), medium (between  $M-SD$  and  $M+SD$ ) and low (from Min to  $M-SD$ ) creativity groups.

Subsequently the differences in analogical reasoning between groups with different levels of creativity were analysed. One-way Anova was used in order to establish these differences. There were no significant differences between groups  $F(2,84) = .41$ , ns.,  $M_{low} = 13.92$  ( $SD = 2.75$ ),  $M_{medium} = 14.55$  ( $SD = 3.86$ ) and  $M_{high} = 15.18$  ( $SD = 4.00$ ). Although differences are not significant, the means of the analogical reasoning tasks score are growing according to the level of creativity.

The relation between creativity and analogical thinking based on the level of creativity was also tested. Surprisingly, Pearson product-moment correlation coefficient  $r(11) = -.54$ , was significant ( $p < .05$ ) for novelty and figural analogical reasoning only in the case of participants from the group with high level of novelty.

#### **4.4.8 Discussion and Conclusion**

In order to test the connection between creativity and analogical reasoning we have tested the differences among the creativity groups based on their scores on the analogical reasoning task. Although the differences between creativity groups on the analogical reasoning task were not significant, the mean of the analogical reasoning task scores shows an ascending tendency. Participants with a higher level of creativity solved more figural analogical reasoning tasks than students from the low creativity level group.

On the other hand, we tested the relationship between the fore-mentioned constructs separately for each group based on the creativity level. We found a significant relationship in only one case: analogical reasoning was associated with novelty only in the group with high level of ability to identify novel creative products. This link was negative, which means that high levels of novelty are associated with low levels of analogical thinking.

These results suggest that the use of analogies does not always have a positive effect on the novelty of products. Çubukçu and Dündar (2007) claimed that analogical reasoning has a negative influence, when analogies are based on the wrong solutions, which cause fixation in the process of problem solving.

However, in this group the number of participants was very low, so we should be careful when generalizing this result. It would be better to repeat this analysis on a higher number of participants with high levels of creativity.

One of the limitations of this research, which can explain the non-significant results, could be the sample size and the distribution of the level of creativity. More than 65% of the participants were in the group of medium level of creativity. Furthermore, differences between genders were also observed. A higher sample size would allow us to complete investigations regarding associations between creativity and analogical reasoning variables based on gender groups as well.

# **CHAPTER V.**

## **THE RELATIONSHIP BETWEEN MOTIVATIONAL AND PERSONALITY CHARACTERISTICS IN DETERMINING THE LEVEL OF CREATIVITY**

### **5.1 Motivational Characteristics and the Level of Creativity**

Deci & Ryan (1985, see Ryan & Deci, 2000), based on their theory of self-determination distinguish two major types of motivation: intrinsic and extrinsic motivation. The results which focused on the relationship between creativity and motivation are mixed, some of the studies having found a strong association between intrinsic motivation and creativity (eg. Amabile, 1985; Ryan & Deci, 2000; Eisenberger & Aselage, 2009, Prabhu, Sutton & Sauser, 2008, Chen, Himsel, Kasof Greenberger & Dmitreiva, 2006), while others suggesting no relationship (ex.: Perry-Smith, 2006) or just very weak correlations (eg.: Dewett, 2007).

### **5.2 The Relationship between Personality Traits and the Level of Creativity**

In the studies which assessed the personality traits of a creative person, data show some inconsistent results. Among the personality variables studied, extraversion was the factor which presented most often a strong correlation with creativity (Sung & Choi, 2009; Furnham & Nederstrom, 2010). At the same time, introversion as a trait might help creativity when the process, the creative thinking needs a longer period of intrinsic consultation, because extroverts tend to get confused more easily (see Batey & Furnham, 2006).

The personality of creative and non-creative architects is also different: creative architects are less respectful and group oriented, more aggressive, more dominant and autonomous and also more open to emotions than architects with a low level of creativity (MacKinnon, 1965).

Besides the Big 3 model of Eysenck and the Big Five model, a new model of personality was proposed (Lee & Ashton, 2004), HEXACO, which encompasses six factors: Honesty-Humility, Emotionality, Extraversion, Agreeability, Consciousness, and Openness (Lee & Ashton, 2004). The Honesty-Humility dimension is a factor defined in the lexical

studies with the following adjectives: honest, modest versus cunning, greedy, pretentious, hypocrite, and braggart (De Vries, Lee & Ashton, 2008).

### **5.3 Study IV – Intercultural Study of Self-perceived Creativity and Creative Potential (Creative Ideation) in Romanian and Italian Architecture Students. The Effects Of Motivational and Personality Characteristics**

#### **5.3.1 Theoretical Basis of the Study**

The self-evaluation of abilities has an influence on our behaviours, performance and efforts we engage when solving a task (Deci & Ryan, 2000; Judge, 2009; Haimovitz, Wormington, & Corpus, 2011).

Researchers have identified different aspects of self-perceived creativity: self-reported creativity, creative self-efficacy, creative personal identity, metacognitive creativity (Pretz & McCollum, 2014).

##### **5.3.1.1 Creative self-efficacy**

Focusing on creative self-efficacy, some studies showed that this phenomenon has a mediating role between creative potential and performance (Choi, 2004; Tierney & Farmer, 2002). In the literature of the field, the investigation of this phenomenon became an important subject (eg.: Beghetto, 2006; Beghetto, Kaufman & Baxter, 2011; Putwain, Kearsley & Symes, 2012).

The innovating behaviour is influenced by the level of creative self-efficacy at the workplace as well (Tierney & Farmer, 2002).

Reiter-Palmon, Robinson-Morrall, Kaufman & Santo (2012) investigated the relationship between self-perceived creativity and creative performance. Among others, their results emphasize that there is no strong connection between self-perceived creativity in general and creative performance.

##### **5.3.1.2 Ideational behavior**

Runco, Plucker & Lim (2000-2001) suggest that there is an efficient modality for assessing creativity, and this is through the ideas created. Ideas have an important role not only for eminent creativity, but also for creativity in everyday life (Runco, Walczyk, Acar, Cowger, Simundson & Tripp, 2013).

There is a large amount of studies which investigate creative ideation (eg: Pannells & Claxton, 2008; Batey, Chamorro-Premuzic & Furnham, 2010; Tsai, 2014). Batey,

Chamorro-Premuzic & Furnham (2010) investigated the relationship between personality traits, intelligence and ideational behaviour. Positive significant associations were identified only between fluid intelligence and ideational behaviour.

#### **5.3.1.3 Culture and creativity**

Culture is an important system of signs and information that influence the relationship between emotions and behaviour (Matsumoto & Wilson, 2008). Being an element of the social context, it could influence creativity, more specifically the level of development (Lubart, 1990, 2010; Antionetti & Cesa-Bianchi, 2003; Mannarelli, 2005), or predictors of creativity, for example the motivation of persons (Amabile 2000).

The results of one of the most recent researches underline that the level of creative potential of Romanians seems to be almost as high as the one of Americans, both for children and adults (David, 2015).

Some results show intercultural differences of self-efficacy. For example, in the case study of Scholz, Dona, Sud & Schwarzer (2002), the Japanese had the lowest level of self-efficacy, followed by that of Chinese participants.

### **5.3.2 Objectives and Hypothesis**

In this study we proposed to explore the possible intercultural differences of creative self-efficacy and creative potential. Moreover, our aim is to analyze the personality and motivational profiles of architecture students from Romania and Italy, and the relationship between these two psychological constructs and creativity.

#### Hypothesis:

1. There are intercultural differences in self-reported creativity and ideational behaviour.
2. There are intercultural differences in terms of the relationship between personality and self-reported creativity and ideational behaviour.
3. There are intercultural differences in terms of the relationship between motivation and self-reported creativity, motivation and ideational behaviour.

### **5.3.3 Method**

#### **5.3.3.1 Participants**

The sample of the study was composed of architecture students from Romania and Italy. The total number of participants was  $N=349$ , of whom  $N=151$  were students from

Romania and  $N= 198$  from Milan, Italy. Regarding participants' mean age, the samples were similar, sample from Romania was 20.76 years old ( $SD= 1.58$ ,  $Min= 19$  and  $Max= 27$ ), and from Italy 20.77 ( $SD= 1.31$ ,  $Min= 19$ ,  $Max= 24$  ) years old.

### **5.3.3.2 Instruments**

**Creativity Scale (CS)** assesses the three dimensions of self-reported creativity: creative self-efficacy, creative identity and creative behaviour. Items are coded on a scale of 5 points, 1 = *I do not agree at all* and 5 = *I totally agree*.

**Runco Ideational Behavior Scale - RIBS-D** (Runco, Plucker and Lim, 2000-2001) is composed form 106 items for several domains. There were selected those items which are related to the architecture domain and everyday life. Participants were asked to assess the frequency of ideas described in each item. A Likert scale with 5 level was used.

The personality traits were assessed with **Hexaco Personality Inventory – HEXACO-PI-R** (Lee and Ashton, 2004, Ashton et. al., 2006). Regarding to this model personality assessment has six factors: Honesty, Emotionality, Extraversion, Agreeableness, Consciousness, and Openness to experience. The inventory has 16 items in each factor and those are coded on a 5 point scale (1= I do not agree; 5= I agree)

**Work Preference Inventory** (Amabile, Hill, Hennessy and Tighe, 1994) was used in order to assess motivational characteristics. This scale consists of two subscales (intrinsic motivation and extrinsic motivation), each has 15 items. Items were followed by a 4-points Likert scale: 1 = never true, 2 = almost never, 3 = almost always 4 = always.

### **5.3.3.3 Procedure**

This study was built as a correlational one, where the influence of personality and motivation on creativity in two cultures was tested. Data collection was achieved in two main steps, the first phase took place in Romania, while the other part was carried out in Italy. IBM SPSS Statistics (20.0) was used for the statistical analysis of the data. The coefficients of effect size were calculated using the software of Soper (2015).

## **5.3.4 Results**

As a first step we analysed the distribution of our data using P-P plot technique. We have eliminated 5 cases which contribute to its normal distribution. After this elimination, the total sample has  $N= 344$  participants,  $N= 195$  from Italy and  $N=149$  from Romania.

Intercultural differences in creativity, motivation and personality traits

Independent sample t test was used in each factor in order to establish intercultural differences. Significant differences are presented in Figure 4.

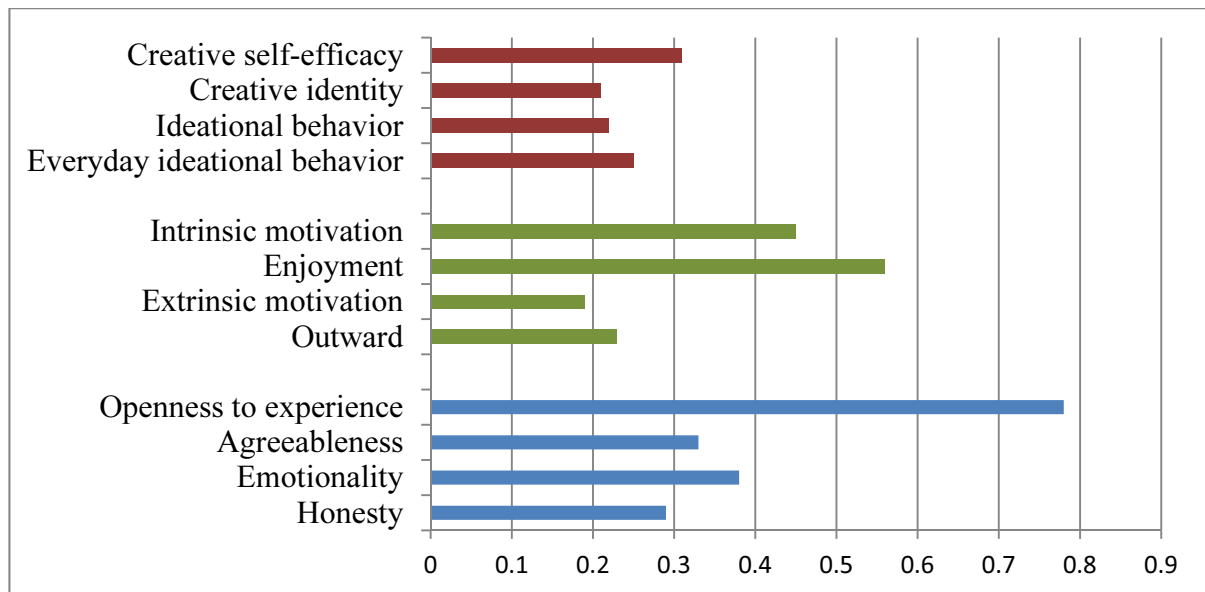


Figure 4. Significant intercultural differences between Romanian and Italian architecture students in creativity, motivation and personality

The highest difference was in one of the personality traits, Openness to experience, the value shows a large effect sizes,  $d=.78$ .

Intercultural differences in terms of the relationship between personality and self-reported creativity and ideational behaviour

Correlation of Pearson product moment was calculated in both samples to obtain more precise data and for detailed analysis of relationship between creativity and personality.

With regard to intercultural differences we can underline that there are significant correlations in both cultures. But according to the results of analysis, there are significant connections which are different in the two groups. Firstly, one interesting result is the negative association between Honesty and Creative self-efficacy ( $r(186)= -.23, p< .01$ ), respectively Honesty and Everyday Creative Potential ( $r(186)= -.54, p<.01$ ). These relations were present only in the Italian sample.

There are also some links that are significant only in the Romanian sample. Consciousness was significantly positive correlated with Creative Identity ( $r(145)= .20, p< .05$ ), and also with Ideational Behavior ( $r(138)= .23, p< .01$ ).

We used Fisher transformation  $r$  to  $Z$  for testing the intercultural differences of the relationship between personality and creativity. We did not find any significant differences.

*Intercultural differences in terms of the relationship between motivation and self-reported creativity, motivation and ideational behaviour*

The third intercultural comparison aimed to test the relationship between motivation and creativity. The associations are almost identical in both samples. Especially the intrinsic motivation and its factors are significantly connected to the dimensions of creativity, to creative self-efficacy, creative identity, creative behaviour and ideational behaviour (significant  $r$ 's value between .16 and .48). Extrinsic motivation was associated significantly with self-efficacy, creative behaviour and creative potential in the Italian sample (significant  $r$ 's value between .15 and .36).

We used Fisher transformation  $r$  to  $Z$  for testing the intercultural differences of the relationship between personality and creativity.

We have found two significant differences in this relationship. The link between extrinsic motivation (Compensation subscale) and Creative Behavior ( $Z= 3.79$ ,  $p< .001$ ), and Everyday Ideational Behavior ( $Z= 2.98$ ,  $p< .001$ ), is stronger in the sample with Italian students than with Romanian participants. The same difference exists between Compensation and self-reported Creativity, but it is only a tendency ( $Z= 1.94$ ,  $p=.05$ ).

### **5.3.5 Discussion and Conclusion**

Culture could be an influencing factor in the level and development of creativity (Lubart, 1990, 2010; Antionetti and Cesa-Bianchi, 2003; Mannarelli, 2005). Based on these observations, we assumed that there are intercultural differences between architect students from Romania and Italy in terms of self-reported level of creativity. The results of the study are consistent with our hypothesis on some of the dimensions of creativity. The participants from the sample comprised of Romanian students granted more importance to creativity and had greater confidence in their creative abilities. Moreover, they had a higher self-reported potential, especially in terms of everyday creativity. Despite this, we did not find any conclusive evidence in terms of differences in creative potential in the domain of architecture.

Another objective of this study was to test the cross-cultural differences in terms of the connection between creativity and personality traits. We found differences in associations in the two cultures, but these were not significant. This suggests that the



environment, as an aspect of culture does not influence the relationship between personality traits and self-reported creativity, or the relationship with the creative potential measured via the ideational behaviour of the participants.

One of the interesting results was the negative association, solely in the Italian sample, of Honesty with creative self-efficacy and ideational behaviour, apparent in the relation to everyday items. When comparing these associations in both cultures, we did not find any significant differences.

Nevertheless, culture, social environment has an effect on predictors of creativity, for example, on the motivation of individuals (Amabile 2000). Therefore, we tested for cultural differences in terms of the possible connections of motivational factors with creativity. The same way as in the case of personality traits, in this instance we have managed to show associations in each culture. Some of these are present only in one of the samples, for example the Pleasure factor was significantly associated with creative potential in the Romanian group, while this connection did not have a significant occurrence in the Italian group.

We compared these intercultural differences in terms of the Compensation factor, Creative behavior and Ideational behavior in general, and we found a stronger association in the group of Italian students.

## **5.4 Study V – The Influence of Creative Potential and Creative Self-efficacy on Determining the Level of Creativity in Planning**

### **5.4.1 Theoretical Basis of the Study**

#### **5.4.1.1 Creative performance and creative self-efficacy**

Previous research demonstrated the positive influence of creative self-efficacy on creative performance. For example, Choi (2004) and Tierney and Farmer (2002) showed that there is a positive relation between creative self-efficacy and creative performance evaluated by their supervisors.

#### **5.4.1.2 Creative performance and creative potential**

Runco (2010) proposed a distinction between two aspects of creativity: creative performance and creative potential. The connection between these two constructs was tested. Some of the researches did not find any relation between creative potential and creative performance. For example, Tsai (2014) demonstrated a weak and also non-significant

relationship between ideational behavior (which refers to creative potential) verbal and figural, which contradicts the assumption claimed by Runco and his colleagues (Plucker, Runco and Lim, 2006).

## **5.4.2 Objectives and Hypothesis**

The creativity of a person was operationalized by their products. In this study we aimed at investigating the relationship between creative self-efficacy and design creativity performance, between intrinsic motivation in the task and creative performance in the domain of architecture, and also the Hexaco structure of personality depending on the level of creativity.

### Hypothesis:

- 1. Factors of the intrinsic motivation will predict creative performance in architectural design.**
- 2. There is a positive relationship between self-perceived creativity and creative performance**
- 3. The predictive value of personality traits shows different patterns, depending on the level of design creativity**

## **5.4.3 Method**

### **5.4.3.1 Participants**

The study sample has  $N= 91$  architecture students from the first year of their study, with a mean age of 19.63 years (Min= 19, Max= 22, SD= .65). Of the total sample  $N= 47$  (51.6 %) were male and  $N= 44$  (48.4 %) female.

### **5.4.3.2 Instruments**

- ❖ ***Creativity Scale (CS)*** assesses the three dimensions of self-reported creativity: creative self-efficacy, creative identity and creative behaviour. Items are coded on a scale of 5 points, 1 = *I do not agree at all* and 5 = *I totally agree*.
- ❖ ***Multifactorial Assessment Scale for the Creative Product*** was used in order to evaluate the level of creativity. The scale is a 24 item observational rating scale which contains bipolar adjectives assessed on a 7-point Likert-scale. Higher score implies a high level of creativity. The scale includes five factors: Novelty (3 items), Resolution (5 items), Elaboration and Synthesis (5 items), Aesthetics and Functionality (5 items) and Applicability (6 items).

- ❖ Personality traits were assessed by *Hexaco Personality Inventory – HEXACO-PI-R* (Lee and Ashton, 2004, Ashton et. al., 2006). With regard to this model, personality assessment has six factors: Honesty, Emotionality, Extraversion, Agreeableness, Consciousness, and Openness to experience. The inventory has 16 items in each factor and those are coded on a 5 point scale (1= I do not agree; 5= I agree).
- ❖ *Intrinsic Motivation Inventory (IMI)* (Deci, Eghrari, Patrick and Leone, 1994) is a multidimensional instrument in order to assess the subjective motivational experiences of participants in a certain task. It includes 22 items. These affirmations are grouped into four subscales: *Enjoyment, Perceived Competence, Pressure, Perceived choice*. Items are coded on a scale from 1 (*it is not true at all*) to 7 (*it is totally true*).
- ❖ *Runco Ideational Behavior Scale - RIBS-D* (Runco, Plucker and Lim, 2000-2001) is composed form 106 items for several domains. There were selected those items which are related to the architecture domain and everyday life. Participants were asked to assess the frequency of ideas described in each item. A Likert scale with 5 level was used.

#### 5.4.3.3 Procedure

Participants had to elaborate an academic project. They were evaluated by specialist based on their projects and MASCP.

IMB SPSS Statistics (20.0) and IBM SPSS Amos (20.0) were used for the statistical analysis of the data. Software developed by Hayes was used to test the mediation value of the variables.

#### 5.4.4 Results

##### Preliminary analysis

Before the main analysis of our hypothesis, we have examined the fidelity of the scales used on our sample. The value of the Multifactorial Assessment Scale for the Creative Product varies between .78 and .96, and .75 and .96 for the Creativity Scale. For our third creativity assessment scale, the values show a similarly good level of acceptance, .80 and .83. The fidelity scores for the subscales of the personality inventory are good, and show values between .74 and .85. After we have excluded item 9, the Cronbach Alpha values became acceptable, with scores between .64 and .82.

### Associations between the independent variables and creative performance

#### **Factors of the intrinsic motivation will predict creative performance in architectural design**

We have analysed the predictive value of motivational traits on creative performance in design.

We did not find significant results, the global score of creative performance was not significantly predicted by motivational characteristics ( $R^2 = .03$ ,  $F(4,57) = .48$ ,  $p = .74$ ). We did not identify significant results for situations where we have used as dependent variables factors from the Multifactorial Assessment Scale for the Creative Product either: *Novelty* ( $R^2 = .01$ ,  $F(4,57) = .18$ ,  $p = .94$ ), *Resolution* ( $R^2 = .07$ ,  $F(4,57) = 1.11$ ,  $p = .35$ ), *Elaboration and synthesis* ( $R^2 = .03$ ,  $F(4,57) = .50$ ,  $p = .73$ ), *Aesthetics* ( $R^2 = .03$ ,  $F(4,57) = .51$ ,  $p = .72$ ) and *Functionality and applicability* ( $R^2 = .02$ ,  $F(4,57) = .31$ ,  $p = .87$ ).

We have also explored the predictive value of intrinsic motivation (measured with the Interest/Pleasure subscale) on creative performance based on gender. In the women's group, there were no significant results (Beta =  $-.19$ ,  $t(33) = -1.19$ ,  $p = .27$ ), but for male participants, intrinsic motivation explained 15 % of the variance in the global creative performance (Beta =  $.38$ ,  $t(32) = 2.34$ ,  $p = .02$ ). Also, resulting our regression analysis, in which we have independently introduced as dependent variables all the factors of creative performance, we have concluded that intrinsic motivation significantly explains ( $p < .01$ ) 20 % from the novelty dimension of the product, but only for male subjects (Beta =  $.45$ ,  $t(32) = 2.83$ ,  $p < .01$ ). This relationship was not significant for female students (Beta =  $-.18$ ,  $t(33) = -1.08$ ,  $p = .28$ ). Moreover, this type of gender difference appears for the Resolution of the product as well. Intrinsic motivation significantly predicts 14 % ( $p < .05$ ) of the variance in logical finality in the group of male participants (Beta =  $.37$ ,  $t(32) = 2.26$ ,  $p < .05$ ), but it is not significant in the group of women (Beta =  $-.18$ ,  $t(33) = -1.08$ ,  $p = .28$ ).

#### **There is a positive relationship between self-perceived creativity and creative performance**

Correlations between creative self-efficacy, creative identity, creative behaviour and factors of creative performance were determined.

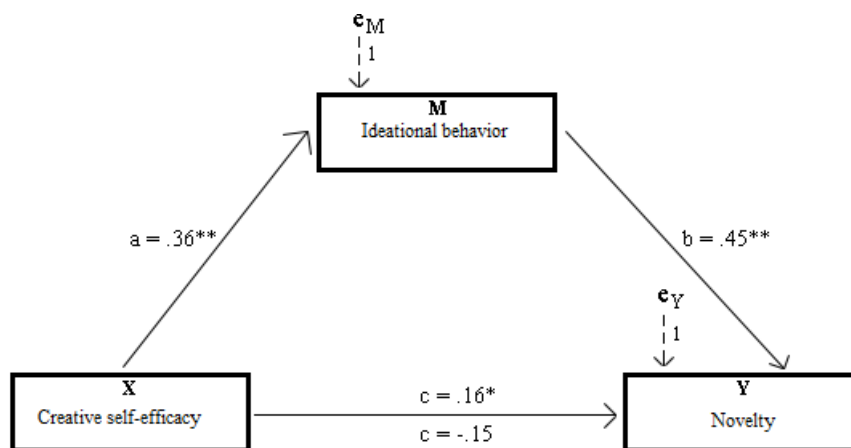
We have not found significant results regarding correlations between *Creative self-efficacy* and the total score of *Creative performance* ( $r(85) = -.11$ ,  $p = .29$ ), *Novelty* ( $r(85) = .01$ ,  $p = .98$ ), *Resolution* ( $r(85) = -.12$ ,  $p = .23$ ), *Elaboration and synthesis* ( $r(85) = -.14$ ,  $p = .20$ ), *Aesthetics* ( $r(85) = -.12$ ,  $p = .25$ ), *Functionality and applicability* ( $r(85) = -.14$ ,  $p = .20$ );

*Creative identity* and global score of *Creative performance* ( $r(85) = .20$ ,  $p = .85$ ), *Novelty* ( $r(85) = -.03$ ,  $p = .75$ ), *Resolution* ( $r(85) = .01$ ,  $p = .88$ ), *Elaboration and synthesis* ( $r(85) = .03$ ,  $p = .90$ ), *Aesthetics* ( $r(85) = .01$ ,  $p = .86$ ), *Functionality and applicability* ( $r(85) = .06$ ,  $p = .52$ ); and neither in *Creative behaviour* and global score of *Creative performance* ( $r(85) = -.09$ ,  $p = .39$ ), *Novelty* ( $r(85) = -.09$ ,  $p = .48$ ), *Resolution* ( $r(85) = -.07$ ,  $p = .50$ ), *Elaboration and synthesis* ( $r(85) = -.06$ ,  $p = .54$ ), *Aesthetics* ( $r(85) = -.11$ ,  $p = .29$ ), *Elaboration and synthesis* ( $r(85) = -.06$ ,  $p = .58$ ).

Since we have not found direct relationships between creative performance and self-perceived creativity, we have completed a few supplementary analyses. We have presumed that the creative potential, measured through ideational behaviour could influence this association. To test this supplementary hypothesis, we have analysed the relationship between factors of self-perceived creativity and factors of creative performance, including ideational behaviour as mediator variable. We have used a macro developed by Andrew Hayes.

When Novelty was our dependent variable, creative potential was a mediator variable between Novelty and self-perceived creativity.

Using ordinary least squares path analysis for our tests, we have found that creative self-efficacy, creative identity and creative behaviour have indirect effects on the novelty of the product. Figure 5 presents this relationship.



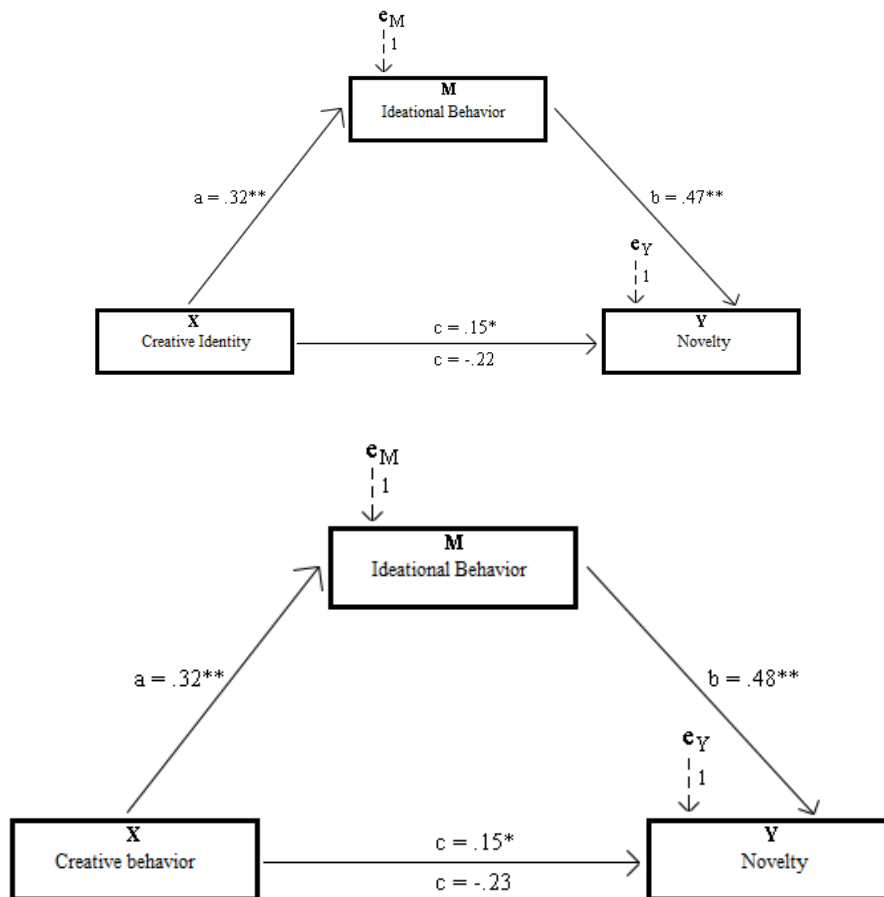


Figure 5. Simple mediational diagram. The values are path coefficients, representing unstandardized regression coefficients (\* $p < .05$ , \*\* $p < .001$ )

**The predictive value of personality traits shows different patterns, depending on the level of design creativity.**

Using the quantity and the descriptive characteristics of performance (min, max, M, SD), we have created a three-level creativity variable: low creativity, medium creativity and high creativity.

The model in which personality is a predictor variable is significant only for participants with a medium level of creativity. Overall, the traits predict 52% of the total variance of creative performance ( $F(6,22) = 3.92$ ,  $p < .01$ ). The following personality traits have significant positive effects: *Openness* (Beta= .51,  $t(27) = 3.08$ ,  $p < .01$ ). *Emotionality* (Beta= .34,  $t(27) = 2.05$ ,  $p = .05$ ) and *Agreeableness* (Beta= .40,  $t(27) = 2.02$ ,  $p = .05$ ) show positive predictive tendencies. *Honesty-Humility* (Beta= -.38,  $t(27) = -2.23$ ,  $p < .01$ ) and *Consciousness* (Beta= -.37,  $t(27) = -2.12$ ,  $p < .05$ ) have significant negative effects on creative performance. Significant effects are presented in Figure 6.

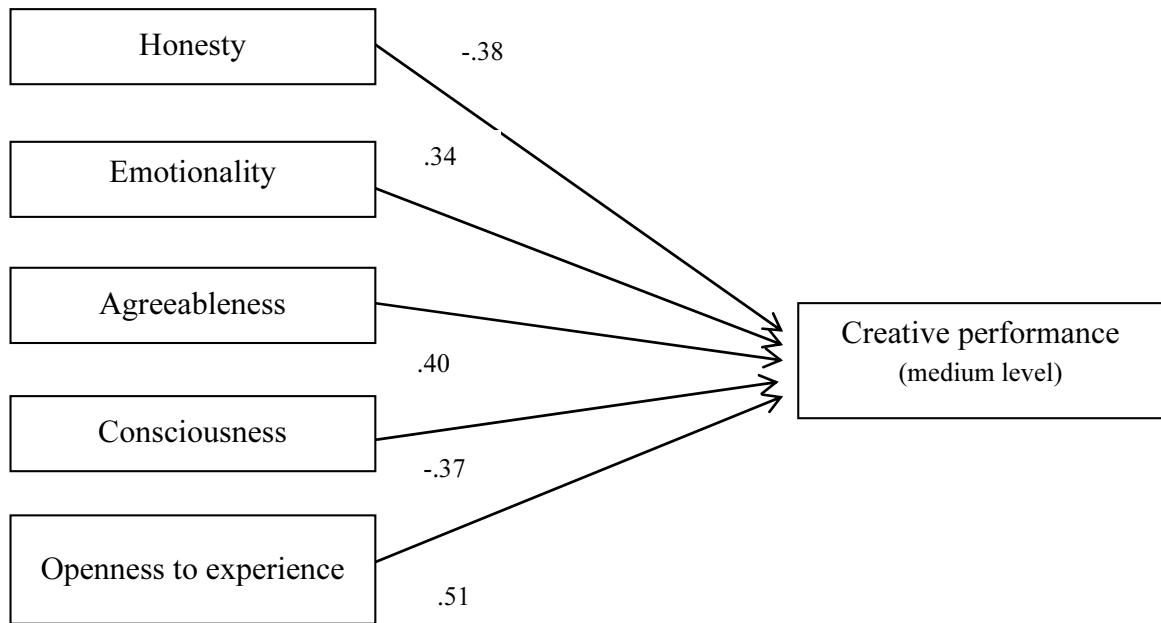


Figure 6. Predictive effects of personality traits on medium creative performance

#### 5.4.5 Discussion and Conclusion

The aim of the present study was to measure creativity based on performance and it proposed the analysis of the connection between personality traits and motivation as well as the influence of creative self-efficacy on creative potential.

In our research the association between intrinsic motivation and creativity was presented only in the subgroup of males. The predictive value of intrinsic motivation on the level of creativity in the female sample was not significant, suggesting an indirect connection between these constructs.

The second objective was to test the relationship between self-perceived creativity and the actual creative performance. The results did not show positive associations; therefore we have opted for more elaborate analysis. These investigations have shown that the relationship between these two constructs is a non – direct one, mediated by ideational behaviour. Creative self-efficacy, creative identity and creative behavior have an indirect effect on product novelty, being mediated by ideational behaviour.

The third aim of this study was to investigate mutual relations between personality traits, based on the HEXACO model, and creative performance. According to our findings, the predictive value of personality traits becomes apparent only in the case of medium level of creativity. Overall, characteristics predict 52 % of the total variance of creative performance.

According to some of the findings of previous research (King, Walker, and Broyles 1996, Rawlings, Vidal and Furnham, 2000; Wolfradt and Pretz, 2001; Sung and Choi, 2009), out of all the personality traits the highest level of positive effect comes with Openness to Experience. Subjects, who are intellectual, creative, unconventional, innovative and ironic, have a tendency to generate creative products.

Unlike the research results of Silvia et al. (2011), where no association was found between creativity and Emotionality and Agreeableness, we detected a positive relationship. However, the same way as in the aforementioned research, Honesty and Humility had a very significant negative effect on creative performance. This result suggests that such traits as Cunningness, Greed, Pretentiousness, Hypocrisy, Pride, Pomposity are linked to creative performance, and are predictive of an average level of creativity.

Another personality trait identified as a negative predictor is Conscientiousness. This association is identical to that uncovered by Feist (1998), Batey and Furnham (2006).

Unlike the results published in this domain, the personality trait of Extraversion was not significantly predictive for creative performance. This result contradicts several findings, for example Feist (1998) found a negative association between Extraversion and scientific and artistic creativity, and a positive association between Extraversion and everyday creativity.



## **CHAPTER VI. FINAL DISCUSSION AND CONCLUSION**

### **6.1 Summary of personal contributions**

#### **6.1.1 Theoretical Contributions**

As a first direction the thesis seeks to analyse the influence of analogical reasoning on the process of generating creative products. The result of the meta-analysis indicates a significant medium effect of analogic reasoning on creativity, this conclusion is consistent with the results of other studies in this field. A further analysis showed that more clues, more sources of analogy have a significant effect on creativity, but a small number of stimuli does not produce the same effect.

Starting from the central conclusion of the meta analysis, studies IIIa and IIIb have addressed this implication on two main axes.

In study IIIa it was investigated the relationship between visual analogy based on the received examples and the level of creativity. The main idea was to test the influence of various types of examples - (domain examples, cross-domain examples, and unspecified domain examples) received before the generating process - on the creative character of the product. It was investigated the effect of analogical distance on the innovative product generation. After analysing the differences between the three groups, the results did not show any significant differences, however after the visual analysis of the medium of creativity in each group, for each factor, we noted that the group with examples from cross-domains shows a higher level of creativity both in Global Creative Performance, and factors of creativity (Novelty, Resolution, Elaboration and synthesis, Aesthetics, Functionality and applicability).

In study IIIb, analogic reasoning was operationalized via solving analogic geometric tasks. The result did not show any associations between these constructs. There were also tested the differences in performance on visual analogical tasks between the three groups formed according to the level of creativity (low, medium and high). Despite being significant, the medium in performance showed a tendency towards ascending.

The candidates assessed as having high levels of global creativity were able to solve correctly more analogical tasks than those who drafted a project on the lower side of creativity.

Under the aegis of another aspect of the thesis we proposed to investigate cultural differences in creative self-efficacy and creative potential in architect students. Our aim was

to analyse the personality profile and motivational features in Romanian and Italian culture and establish their relationship with creativity. In addition, the results of this study suggest that in general Romanian architect students have a greater potential for creativity than the Italians. But we have not found differences in creative potential in the field of architecture.

The relationship between creativity and personality traits does not seem to differ in the two countries, but the connection between motivational and creative features shows some significant differences. The positive association between creativity and compensation, that is motivation, is achieved by external factors, this pattern is stronger in the case of Italian students than in Romanians. Another interesting result refers to the relationship between creativity and intrinsic motivation. In contrast to the result of other research projects where it was demonstrated that there is a positive relation between these constructs, the associated value was present only in the case of males. This means that intrinsic motivation in a given task is predictive for the level of novelty and the logical finality of the elaborated product in the case of male participants. At the same time, the predictive value of personality traits appears only in the situation where the level of creativity seems to be at the lower end.

As for the connection between creative self-efficacy and the actual creative performance we have identified a factor that contributes to the development of this connection. This factor is none other than the creative potential.

### **6.1.2 Methodological Contributions**

From a methodological standpoint, our aim was to complement and improve the tools used to assess creativity. We have developed a specific tool with applications in the domain of architecture that can be used to evaluate the characteristics of a creative product. Following the validity and reliability analysis we got to the conclusion that this tool can be used to determine the level of creativity in design. Based on the data and the tool elaborated, we have developed a computer program that is basically a web application based on our scale that offers the possibility to generate feedback related to the level of creativity of an architectural product.

Another important methodological contribution is that while using a certain existing toolset, new tools were introduced in the methodological analysis of creative correlations these not yet being tested on samples in the areas covered by us. One of them would be HEXACO Personality Inventory.

A third relevant methodological contribution is linked to the tools used in analogical reasoning. In our studies we have elaborated an evaluation test for analogical reasoning. The evaluation of analogical thinking in the case of future architects was done with the adaptation, modification and completion of some analogical tasks used in previous studies. The evaluation of the participants' analogical thinking was accomplished with the aid of a tool developed on the basis of analogical reasoning tasks used previously. This collection contains 39 figural tasks.

### **6.1.3 Practical Contributions**

The practical contribution of the thesis is to raise interest towards the factors that influence the level of creativity.

At the same time, the studies show that the evaluations and observations received have an important role in the academic and scholastic field. Given the good psychometric properties of the multifactorial evaluation scale of the creative product, based on this we have developed a computerized evaluation program. The program is accessible for both students and professors and its purpose is to develop the students' self-reflection in the creative process and implicitly the improvement of the creative qualities of the architectural products. This evaluation has a visual form based on the scores obtained for each factor. The role of the evaluator can be fulfilled even by a teacher. Taking in consideration the easy accessibility and utility of the software, this becomes an adequate instrument for the evaluation of the capacity of students. Each project evaluation is stored, therefore the students can compare the levels of development and they can keep a precise track record of the evolution of their creative skills. Keeping in mind the utility of a feedback, this application can be used not only for evaluation but also for the development of students' creativity.

As part of the practical application, in the future we could instruct a designer who could teach the students how to select stimuli that influence the originality of a product in a positive way, avoiding the elements that can cause fixation.

## **6.2 Limitations of the Studies and Future Research Directions**

The aim of the thesis was to analyse the cognitive, motivational and personality correlates of creativity in architecture. The main idea of the thesis was an overall investigation of the correlates of creativity in a more exact area, namely architecture. The studies presented in this thesis have some limitations. In this sequence of the thesis we will

summarize the general and the specific limits of each study, so as to present an adequate image of these, and to propose possible future directions.

Firstly, when we generalize the findings, we have to take into account the fact that the investigations were conducted on a consignment of architect students, the target of the investigations was the specific type of creativity that becomes apparent in design and planning in architecture.

Our studies are also limited by the self-reporting of certain data that could serve as a source bias of the results. Another limitation would be the representative character of the sample. The participants of this study were selected from a single university from Romania and Italy. However, even if the analysed sample is not representative and has a smaller number of participants, it includes a sufficient number of participants for the results to be extended to this population.

In addition to these overall limits, the five researches presented in this thesis have specific limits of their own.

In the case of the validation studies of the tools (self-reported Creativity Scale and Multifactorial Assessment Scale of the Creative Product - Study 1.a and Study 1.b) limitations stem from the fact that the data are cross sectional and do not allow us to determine directionality, test-retest validity or changes over time, in defining the elements of external validity of the tools. Future studies should test the test-retest validity of this specific toolkit.

In the case of Study II we have presented a meta-analysis of the existing research on the influence of analogic reasoning on generating creative products. The main limit in this case is the very small number of studies reporting quantitative data from this field. Another limit is linked to the studies that manipulate stimuli. They generally state only the absence vs. presence of these, but they do not specify exactly their quantity. Therefore, further studies should target to control the amount of stimuli and identify the adequate number for the analogy and for developing the creative product.

Due to the differences between experts and novices in the use of analogy for problem solving in design (Casakin and Goldschmidt, 1999; Casakin, 2004, 2010; Bonnardel and Marméche, 2004; Ball, Ormerod and Morley, 2004), future studies should investigate the influence of analogic reasoning on the level of creativity in various groups formed on the basis of their experience.

The main limit of Study IIIa is that the examples provided were controlled along only one dimension. These were selected by the students and only their theme was specified to ensure their intra-and inter-domain character. The differences between the examples used by students in the same experimental group could influence the results received. It is advisable that in the future studies that analyse the effect of creativity in architecture to use the same examples within the same group. The presence of a control group should be an important criterion for all future research. In our study this could not be accomplished because the project used was part of the academic curriculum.

In Study IIIb there was used an instrument for the evaluation of analogical reasoning that was created by us. Despite the fact that the instrument created was tested in a pilot study, it would have been preferable that the psychometric properties of the final test to be analysed on a larger sample with participants from various domains.

Another limit would be the quantitative and correlational nature of the data from Study IV. The recent scientific literature in the field considers that in the attainment of intercultural studies it would be more appropriate to combine qualitative and quantitative methodology. Qualitative data may provide new information for the interpretation and clarification of results.

Just as in the previous research, Study V has a few limits of its own. The most important is its cross-sectional design that does not permit the generation of causal inferences; despite this the testing of the association between the investigated constructs is still relevant. We need to take into consideration the small number of participants especially in this study, because the groups were created based on the level of creativity and following the distribution into three groups (low, medium and high levels of creativity) we had a small number of participants.

In conclusion, we have to be cautious when interpreting these results. At the same time, the results for gender differences in the level of creativity and motivational characteristics that are predictive for creativity, intercultural differences, the profile of the creative student, are all data that can be used in the creation of a program to be used to improve creative performance. In such a program it would be crucial to train a designer to teach students to select stimuli that have beneficial effects on the originality of a product or to avoid stimuli that can cause fixation in the creative process.

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