

MEANING-BASED ASSESSMENT IN CREATIVE DESIGN

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ABSTRACT

The paper reports a novel approach to the assessment of design creativity by means of the meaning system. The introduction of main constructs of meaning corresponding to the theory of meaning by Kreitler and Kreitler, is followed by the presentation of theoretical and empirical considerations supporting the hypothesis that it is possible to assess design creativity in terms of the meaning system. An empirical study is presented, describing one specific set of meaning variables, i.e., types of relation that was found in previous studies to differentiate significantly between the more and less creative participants. The findings confirmed the expectation that this particular set of meaning variables - types of relations - characterizes the more creative students as compared to the less creative ones. The results showed that the more creative designers tended to focus on the personal-subjective meanings, as well as on some components of the interpersonally-shared meanings, whereas the less creative designers focused mainly on the interpersonally-shared meanings.

Keywords: creativity, architectural design, theory of meaning, cognitive processes, meaning system, types of relation

1 INTRODUCTION

Creativity is considered as one of the major constructs employed for identifying high ability [1]. Csikszentmihalyi [2] refers to creativity as the set of high abilities necessary for producing remarkable discoveries, communicating unusual thoughts, making profound judgments, and understanding reality in extraordinary ways. Creativity is also defined as a cognitive process of original problem solving through which innovative outcomes are produced [3], [4], and [5]. Creativity plays a major role in domains demanding innovation, such as design problem solving, where a design outcome is expected to be not only aesthetic and useful, but also innovative [6]. The assessment of creativity is a main concern of design practice, as well as of design education. In the design studio students acquire skills, knowledge and expertise, develop criteria for assessing their outcomes, and get criticism from their tutors [7], and [8]. However, neither in design practice nor in design education design outcomes are assessed in a manner that considers the main components of creativity [9], [10], and [11]. Creativity in general, and design creativity in particular, are difficult subjects for assessment. Some of the reasons are due to the complexity of measuring creativity, the rich diversity of its manifestations, and the many theories attempting to cope with the involved processes and features.

It happens often in design practice, such as competitions, or in design studios, that design assessment is based on shared consensus among evaluators. But, when the assessment of design creativity is not well understood, the criteria used in the evaluation of designs turn out to be more intuitive than explicit. Regrettably, instead of assessing the creativity of a design, evaluators often tend to focus on other aspects, such as aesthetic formalism, or graphic skills [12] and [13].

Thus, the major objective of this study was to explore the cognitive processes involved in creative design in architectural design, by means of the Meaning System. Specifically, we centered on the meaning variable of types of relation. Identifying the cognitive processes involved in creative design may provide tools for assessing and promoting creativity in design problem solving. The cognitive processes were explored in the framework of the Meaning Theory (see section 2).

2 THE NATURE AND ASSESSMENT OF MEANING

In this study the assessment tool for creativity was grounded in the Theory of Meaning. A brief description of this approach precedes the discussion of the relation between the meaning variables and creativity. The Theory of Meaning [14] describes the function of meaning processes in regard to

cognition, emotions, personality and behavior. It shows how cognitive contents and processes are used for defining, expressing and communicating meanings for different purposes, e.g., identifying inputs, comprehension, problem solving, or communication. Meaning consists of meaning units, which include two components: 'the referent' which is the input, the stimulus, or the subject to which meaning is assigned, and 'the meaning value' which is the cognitive contents designed to express or communicate the meaning of the referent. Examples of meaning units are: "bridge – serves for crossing", "park – is located in the city", "design – is produced by architects". In these meaning units, 'bridge', 'park', and 'design' are the referents and 'serves for crossing', 'is located in the city' and 'is produced by architects' are the meaning values.

Every meaning unit can be characterized in terms of meaning variables of the five following types: (a) *Meaning Dimensions*, which characterize the contents of the meaning values from the viewpoint of the specific information communicated about the referent, such as the referent's Sensory Qualities (e.g., Sea - blue), Feelings and Emotions it evokes (e.g., Bridge - admiration), Range of Inclusion (e.g., Building - entrance, facade, and roof); (b) *Types of Relation*, which characterize the immediacy or directness of the relation between the referent and the meaning values, for example, attributive (which is direct, e.g., Bridge - large), comparative (which involves an additional referent, e.g., Skyscraper - taller than a house), exemplifying instance (e.g., Skyscraper – Empire State) or metaphoric-symbolic (e.g., Sea – the spirit of freedom); (c) *Forms of Relation*, which characterize the manner in which the relation between the referent and the meaning value is regulated, for example, in terms of its direction (positive or negative; e.g., Shopping Center - is not a public space), quantification (absolute, partial; Library - sometimes closed), or form (factual, desired or desirable; Elder - should be respected); (d) *Referent Shifts*, which characterize the relation between the referent and the presented input (e.g., when the input is “day”, a response that focuses on “night” represents a shift to the opposite while a response that focuses on “morning” represents a shift to a part of the input); (e) *Forms of Expression*, which characterize the forms of expression of the meaning units (e.g., verbal, denotation, graphic) and its directness (e.g., actual gesture or verbal description of gesture) [14].

Each of the five sets of meaning variables is complete in itself, and independent of the rest of the sets. In consequence, characterizing a meaning unit entails using one variable from each set. Therefore, when we have a group of meaning units coded in terms of meaning variables and we count the frequencies of meaning variables used in characterizing these meaning units, we obtain five independent groups of frequencies, namely, one for meaning dimensions, one for types of relation, one for forms of relation, one for shifts of referent, and one for forms of expression. Each of these five groups of frequencies amounts to the same total, but represents different meaning variables.

Every person disposes over a certain selected part of the meaning system which represents the specific tendencies of that person to apply the variables of the meaning system in information processing. Thus, each person tends to use specific meaning variables with higher frequency, and other meaning variables with medium or low frequency. The frequencies with which the person tends to use each meaning variable can be assessed by means of The Meaning Test, and constitute the individual's meaning profile [see Method].

The most important function of meaning is to make available the cognitive contents and processes needed for performing different cognitive acts. Studies showed that each meaning variable represents a specific set of contents and processes. For example, the meaning dimension Locational Qualities represents the set of contents denoting location (e.g., geographic) and the processes involved in dealing cognitively with locations (e.g., identifying, specifying, recalling, transforming locations). Further studies showed that each type of cognitive act corresponds to a specific pattern of meaning variables that provide a description of the contents and processes involved in its enactment. For example, meaning variables involved in planning include structure, temporal qualities, and causes and antecedents [15], [16] and [17]. If the individual's meaning profile includes a sufficient proportion of the meaning variables included in the pattern corresponding to the particular cognitive act, that individual will be able to perform well the particular cognitive act [14], [18], [19], [20], and [21].

In the present study we applied the Meaning Test to assess the meaning variables of types of relation, which were found to be one of the most significant variables in the system of meaning for the assessment of design creativity.

2.1 Types of relation

Types of relation (TR) characterize how a meaning value of any meaning dimension is related to the referent. According to Kreitler and Kreitler [22] the relation may involve different processes. Based on previous research, four main types of relation, each of which includes two or more variants, have been identified:

TR1. The Attributive Relation

The meaning values relate to the referent directly as qualities, properties, events, or actions. It includes two variants: (i) the substantive relation (TR 1a), where meaning values are seen as properties or characteristics of the referent, as a concrete or abstract substance (i.e., a static substance-quality relation). For example, *building*, "is a shelter, is in the neighborhood", and (ii) the actional relation (TR 1b), where meaning values are seen as qualities or characteristics dependent on the activity of the referent, as concrete or abstract agent (i.e., a dynamic doer-action relation). For example, *building*, "provides shelter, is located in the neighborhood."

TR 2. The Comparative Relation

The meaning values are related to the referent indirectly by means of the mediating role of another referent, which is often on a level of generality or abstractness similar to that of the first referent. The four variants are (i) the relation of similarity (TR 2a), concerned with identity or synonymy, matching, equivalence, as well as similarity in some sense. For example, *gated neighborhoods*, "like fortresses, both are isolated places"; (ii) the relation of difference (TR 2b), which is concerned with dissimilarity, contradiction, mismatch, reversal, contrast, inversion and antonym. For example, *open-ended system*, "the opposite of closed-ended system"; (iii) the relation of complementarity (TR 2c), which has to do with reciprocity. For example, *Twin Cities*, "city A is related to city B and city B to city A"; and (iv) the relational relation (TR 2d), where the status of the meaning value is concerned with some other meaning value or referent that is compared explicitly (i.e., like *taller than*) or implicitly (i.e., in apparently non-comparative terms like *long* and *wide*). For example, *Jerusalem*, "the holiest city in the world", or "Grey" – "lighter than black".

TR 3. The Exemplifying-Illustrative Relation

The meaning values relate to the referent as examples. The three variants are (i) an exemplifying instance (TR 3a), that presents the meaning value through an event, an object, an animal, or a person which is given the role of example for the referent or some feature(s) of the referent. For example, *City*- "Paris"; (ii) an exemplifying situation (TR 3b) that presents the meaning value by means of a situation, and is richer in details than an exemplifying instance, including sometimes even some activity. For example, *dreaming*, "a boy sitting on a bench in a peaceful park, looking at the horizon"; (iii) an exemplifying scene (TR 3c), which refers to the meaning value by means of describing a situation, story, or succession of events organized in a dynamic sequence. For example, *seduction*, "a couple was walking along the river; at some point the man smiled at the young lady, and gave her a bunch of flowers. Thereafter, he whispered something to her, while they stop to contemplate the moon."

TR 4. The Metaphoric-Symbolic Relation

The meaning values represent contents that do not belong conventionally to the referent's domain, but relate to the referent metaphorically, by means of another referent, often more concrete or specific than the first one. The four main variants are (i) the relation of interpretation (TR 4a), that is about stating an unorthodox interpretation of the referent in abstract terms. An instance may be *God*, "is everywhere but cannot be found anywhere"; (ii) the conventional metaphor (TR 4b), which consists of a meaning value that is related to the input by means of a metaphor that has turned into an idiom or has been literalized by the language (i.e., a dead metaphor), for example, *Being angry* - "blowing off a fuse" ; (iii) an original metaphor (TR 4c), which consists of representing the referent through a relatively concrete instance, situation, or scene that does not belong to the same domain as the referent. For example, *loneliness*, "living on the top of a high mountain where no one sees you"; (iv) the symbol- a particular kind of complex metaphor- that represents various features of similarity between the metaphoric image and the original referent, among which there is at least one pair of contrasting characteristics presenting a problem that is resolved through the metaphoric image [23]. For example, *hatred*, "it is like a sword that hurts every other person but in the end it turns against oneself".

Previous studies showed that the attributive and comparative types of relation are used by subjects preponderantly when they are requested to communicate interpersonally-shared meanings, namely, those that can be used in a dictionary or can be assumed to be familiar to most people knowing the language and communicating with each other. Further, the exemplifying-illustrative and metaphoric-symbolic types of relation were found to predominate when subjects are asked to communicate or express their personal meanings, disregarding the interpersonally-shared aspects of meanings [24], and [14]. Therefore, it is justified to refer to the attributive and comparative types of relation as representing the interpersonally-shared mode of meaning, and consider the exemplifying-illustrative and metaphoric-symbolic types of relation as representing the personal-subjective mode of meaning. The sphere of meaning includes both modes, though in different measures or with varying salience in different individuals and situations.

3 MEANING VARIABLES, CREATIVITY, AND DESIGN CREATIVITY

The study presented in this paper is grounded in the psychosemantic conception of meaning. Considerations of different kinds have led to the assumption that the meaning system may be an appropriate tool for assessing creativity potential, and design creativity in particular. One major consideration is based on previous findings about the role played by meaning variables in various cognitive functions, such as planning, curiosity, exploration, problem solving, mathematics and comprehension [25], [26], [27], [28], and [29]. Also creativity was found to be related to specific meaning variables, which include those based on the types of relation of personal-subjective meaning in addition to those salient in interpersonally-shared meaning [30]. Second, prior research demonstrated that endorsement of specific meaning variables in an experimental setting, principally those concerned with personal meaning (viz. exemplifying-illustrative and metaphoric-symbolic types of relation), resulted in enhanced manifestations of creativity. For example, increases in fluency, flexibility, elaboration and originality in the Wallach and Kogan test, increases in the number of original responses in the Rorschach test, and increases in original associations [19], [31], [32], and [33]. In addition, several studies with different groups of participants showed that under the impact of induction of personal meaning - as compared with the performance under the impact of interpersonally-shared meaning induction - participants scored higher on visual memory tasks, identifying embedded figures, recalling faces; reported many more unusual and bizarre experiences; produced a greater number of associations; grasped texts more often in metaphoric terms; had lower scores on reality testing and emotional control in the Rorschach test; and had higher scores on scales assessing emotions (negative as well as positive) (Kreitler, 2009). Remarkably, the promotion of thinking skills of creativity in teacher trainees resulted in changes in meaning variables that were similar to those identified earlier as producing increases in creativity manifestations viz. the exemplifying-illustrative and metaphoric-symbolic types of relation [21]. Third, since creativity can be promoted by particular personality tendencies [34] and is also assessed by means of personality tendencies [35], [36], and [37], it is of advantage in regard to assessing design creativity that the Meaning Test was shown to enable the assessment of personality traits in addition to cognitive processes [14], and [38]. Further advantages of the meaning test are that it can be administered to design students in different years of study, and that it is not restricted to verbal responses but allows also drawing ones so that it is adequate for creative domains such as design.

4 METHOD

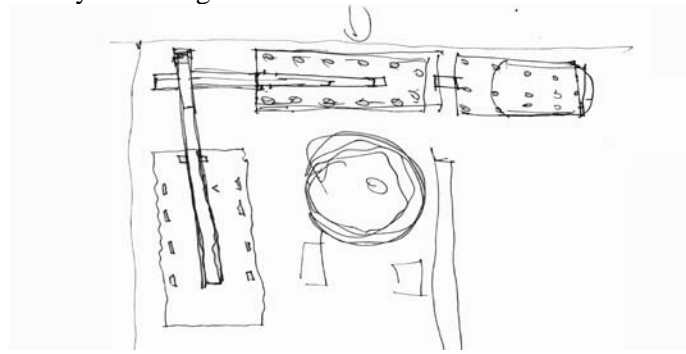
4.1 Participants

Fifty two architectural students in their first to fifth year of studies (35 men and 17 women) participated in the empirical study. They were in the age range of 21 to 35 (Mean 22.85 yrs), with a mean of 13.91 years of education, most of whom were born in Israel (85.11%), They were recruited randomly from the student population in the first to fifth year in a college in central Israel.

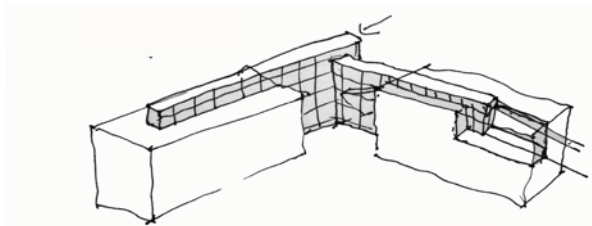
4.2 Instruments

Students were provided with general instructions and materials in order to produce a creative design for a small museum. A major design goal was to promote cultural and artistic activities in a small

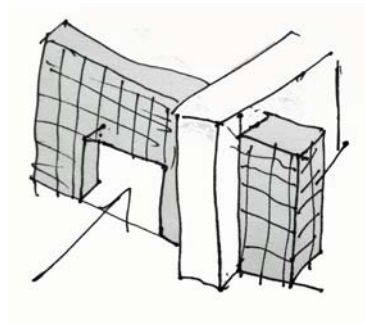
historical town. The building was to be located in an area characterized by historical buildings such as a 100 year old Town Hall. Figures 1 and 2 present examples of high-creativity and low-creativity design solutions produced by two design students.



(a)



(b)



(c)

Figure 1. Sketch illustrating a high-creativity solution for the design of a museum – (a) plan; (b) and (c) perspectives

In addition students completed the standard Meaning Test [14] in which they were asked to communicate to another imagined person of their choice (who understands language and other means of communication, but not the meaning of the specific stimuli) the interpersonally-shared and personal-subjective meanings of 11 standard stimuli representing familiar words (e.g., street, bicycle, telephone, art), using any verbal or nonverbal means of communication they regard as adequate (write, draw, describe drawings or objects, etc.). The responses are coded into units, and each unit is characterized in terms of five sets of variables, one from each set, e.g., meaning dimensions that characterize the contents, and types of relation that characterize the bond within the unit (e.g., comparative). The coding of the responses is done by a computer program [15].

4.3 Procedure

The whole design session lasted approximately two hours. Four architects, with an experience of at least 10 years in design practice, evaluated independently the creativity of the designs using a scale of 1 to 5. The evaluators were naïve to the goals of the study and did not know the students. They were asked to evaluate the outputs of the students and not the process of designing at which they were not present.

Concerning the evaluations by the architects, we checked the degree of correspondence between the four evaluators with respect to creativity. The scores of the four referees were considered as items in a scale. Since the reliability coefficient of the scale was satisfactory (Cronbach's $\alpha = .73$), the scores assigned to each individual participant in regard to creativity were combined by calculating for each participant the mean of the four evaluations.

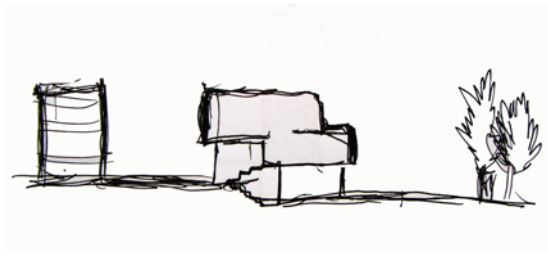
In addition to high inter-judge reliability, the evaluation of overall creativity has also validity. A previous study [7] showed that the evaluation by the expert architects of the overall creativity in the designs corresponds mainly to a factor that may be labeled as 'innovation in design'. Hence, when expert designers are asked to evaluate creativity in design they tend to focus mainly on innovation, which is the major criterion of creativity.

A week after completing the design task, the students were administered the Meaning Test in design studio sessions. During the testing, none of the participants or the test administrators was aware of the hypothesis of the study. Moreover, the Meaning Test was coded by experimenters who did not know the hypothesis. The coding task dealt with identifying in the responses meaning units, which were characterized in terms of one variable of each of the five classes of variables (i.e., meaning dimensions, referent shifts). As we noted before, in the present study we focused on the meaning variables of types of relation. Variables were then summed up in order to obtain the meaning profile of each individual participant (the frequencies of applying the meaning variables of types of relation in communicating the meanings of the 11 stimuli). The reliability of coding across two different coders was satisfactory (correlation coefficients for two coders for the different meaning variables ranged from $r = .91$ to $r = .99$).

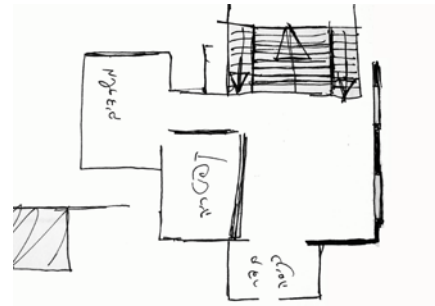
The meaning profile of the students high in creativity and low in creativity (the two groups were defined as above and below the median of creativity in the group, viz. 3.7) were compared by t-tests. The meaning variables that differentiated significantly between the groups (considering the Bonferroni criteria) were considered as the set of variables that represent the cognitive processes contributing to creativity.



(a)



(b)



(c)

Figure 2. Sketch illustrating a low-creativity solution for the design of a museum – (a) perspective; (b) section; (c) plan

5. RESULTS

Table 1 presents the results of comparing the groups of students defined as “higher in creativity” and “lower in creativity” in the meaning variables of types of relation. The findings show that the students who were rated as more creative differed from the others in nine out of fifteen meaning variables. The differences refer to: Comparative: similarity, relational, complementary; Exemplifying-illustrative: Situation, scene; Metaphoric-symbolic: conventional metaphor, original metaphor, symbol, and Total: personal-subjective meaning. More specifically, the significant differences indicate that in all these variables, the highly creative participants scored higher than those identified as lower in creativity. However, findings that are based on a significance level of $p < .05$ need to be considered with caution.

because the Bonferroni test requires $p < .001$ for findings on the $p < .05$ level. In our context this indicates that the most characteristic tendencies of the highly creative in comparison to those lower in creativity are the scores of the comparative: similarity, comparative: relational, exemplifying-illustrative: situation, exemplifying-illustrative: scene, metaphoric-symbolic: symbol, and the total of personal-subjective meanings. In the following variables there were no significant differences between the mean responses of those higher in creativity and those lower in creativity: Attributive: Substance to agent, Attributive: action to agent, Comparative: Difference, Total: Interpersonally-shared meaning, Exemplifying-illustrative: Instance, and Metaphoric-symbolic: Personal interpretation. In sum, there is evidence for a particular meaning profile characterizing the creative group.

Table 1. Mean differences between the participants high and low in creativity in the meaning variables of types of relation

Meaning Variables	Mean and SD of Students High in Creativity (n=26)	Mean and SD of Students Low in Creativity (n=26)	t-value
<i>TR 1a</i> Attributive: substance to agent	12.56 [3.16]	14.74 [4.15]	0.66
<i>TR 1b</i> Attributive: action to agent	16.69 [3.82]	18.73 [4.99]	1.68
<i>TR 2a</i> Comparative: Similarity	9.56 [2.58]	6.74 [2.17]	4.36***
<i>TR 2b</i> Comparative: Difference	8.47 [2.64]	7.50 [2.75]	0.42
<i>TR 2c</i> Comparative: Complementary	3.98 [1.12]	2.95 [1.27]	3.11**
<i>TR 2d</i> Comparative: Relational	4.61 [2.41]	2.67 [0.98]	4.57***
Total: Interpersonally-shared meaning	55.26 [5.74]	53.33 [5.69]	1.19
<i>TR 3a</i> Exemplifying-illustrative: Exemplifying instance	7.21 (2.44)	5.94 (1.94)	1.57
<i>TR 3b</i> Exemplifying-illustrative: Situation	5.47 [1.73]	2.68 [1.31]	6.57***
<i>TR 3c</i> Exemplifying-illustrative: Scene	3.43 [1.84]	1.57 [0.01]	5.17***
<i>TR 4a</i> Metaphoric-symbolic: Personal interpretation	2.59 [1.14]	2.81 [1.68]	0.55
<i>TR 4b</i> Metaphoric-symbolic: Conventional metaphor	4.65 [1.25]	2.13 [1.28]	2.44*
<i>TR 4c</i> Metaphoric-symbolic: Original metaphor	6.51 [2.69]	3.60 [2.48]	4.06**
<i>TR 4d</i> Metaphoric-symbolic: Symbol	1.99 [0.55]	0.14 [0.11]	16.87***
Total: Personal-subjective meaning	31.86 [5.42]	19.18 [4.18]	9.39***

* $p < .05$, ** $p < .01$, *** $p < .001$

6. DISCUSSION

The study shows that the more highly creative differ from the less creative design students in several of the meaning variables representing types of relation. Thus, the more highly creative students score higher in five of the seven variables of the personal-subjective mode of meaning: exemplifying-illustrative: situation, exemplifying-illustrative: scene, metaphoric-symbolic: conventional metaphor, metaphoric-symbolic: original metaphor, and metaphoric-symbolic: symbol. Hence, they also scored significantly higher in the total of the personal-subjective mode of meaning. Of the six variables representing the interpersonally-shared mode of meaning the highly creative design students scored

significantly higher than those lower in creativity in three variables, all of the comparative types of relation: similarity, relationality and complementarity. The highly creative students did not differ from those lower in creativity in the total of the interpersonally-shared meaning mode, in the two attributive types of relation, as well as in the types of relation comparative: difference, exemplifying-illustrative: exemplifying instance and metaphoric-symbolic: interpretation.

In sum, the highly creative design students are characterized by a salient tendency to use the personal-subjective mode of meaning with the associated cognitive processes. These meaning variables represent cognitive processes marked by combining disparate domains of discourse and binding together abstract concepts with figural-concrete elements. Notably, the three variables of the comparative type of relation in which the highly creative design students scored significantly better also denote similar tendencies: similarity, relationality and complementarity consist in binding together disparate domains of discourse.

However, no less notable for characterizing the highly creative design students is the finding that they did not differ significantly from the less creative ones in major variables of the interpersonally-shared mode of meaning. Thus, the emphasis on the personal-subjective mode of meaning did not entail in their case a weakening of the interpersonally-shared mode of meaning.

In more general terms, the more creative design students tend to focus on the personal-subjective mode of expression without however distancing themselves from the reality-bound aspects of interpersonal communication. They have access both to the internal as well as external reality, to the personal and interpersonal, to the subjective and the objective aspects. Notably, this set of meaning variables matches in most components the set of variables found to characterize creative children as compared with less creative ones [30].

Access to both worlds is of importance in art domains. Even when artists focus on their subjective view of the world and express their own personal experiences, they stay aware of the external audience and need to consider interpersonally-shared reality in order to communicate adequately and remain relevant. Yet, multi-accessibility is of great advantage particularly for creativity in design and architecture. Whereas in other art domains, such as painting or literature, considering interpersonally-shared reality is useful, as well as desirable and recommended, in design and architectural design it is a must [22]. Design and architectural design consist in producing outcomes that need to satisfy both aesthetic standards as well as functional and programmatic requirements. Hence, architecture and design per se represent the combination of the personal-subjective and the interpersonal-objective.

Some of the findings confirm previously often reported results about cognition that characterizes creativity, such as metaphors and restructuring. Findings from this study indicate which cognitive processes need to be emphasized and especially clarified for promoting creativity in design problem solving, and specifically in the design studio.

The implications of the findings are that education in design and architectural design needs to consider the pair of approaches represented by the personal-subjective and by the interpersonal-objective modes of meaning. Emphasizing both of these poles systematically is likely to result in enhanced creativity in design students. This conclusion is not merely programmatic. Since the theory of meaning has generated a structured procedure for training specific meaning variables, it is possible to apply it in the design studio for increasing students' responses or images that represent metaphors, symbols and exemplifying-illustrative situations and scenes so as to enhance their creativity in design [24].

7. IN CONCLUSION

This study presented a new theoretical approach to conceptualizing design creativity and an innovative empirical methodology for the assessment of design creativity by introducing major constructs of meaning grounded in the theory of meaning. It corroborated the hypothesis that it is possible to assess design creativity in terms of the meaning system. The cognitive processes involved in creative design, which were identified in the framework of the meaning theory, are considered as providing designers with better tools for understanding, assessing, and promoting creativity in design problem solving, both in design practice and in design education.

Gaining insight in regard to the existing differences between more creative and less creative designers in terms of the meaning variables of types of relation has several benefits. In the present context a major advantage is the possibility of helping designers of medium or even low creativity to develop their cognitive structures, and cognitive processes involved in creative problem solving tasks.

In a future study we plan to extend the scope of the present investigation, by assessing design creativity on a broader basis, considering all other constructs of meaning of the theory of meaning. This will provide a more comprehensive overview of the cognitive processes involved in creativity and will enable planning the phase of intervention whereby enhancing the relevant cognitive processes will be incorporated in the regular curriculum of the design studio.

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