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THE NEED FOR COGNITIVE CLOSURE AND THE LEVEL OF CREATIVE  
BEHAVIOR IN RELATION TO THE COMPREHENSION AND DESIGN OF  
COMPLEX SPATIAL STRUCTURES

POTRZEBA POZNAWCZEGO DOMKNIECIA I POZIOM ZACHOWAŃ  
TWÓRCZYCH A ROZUMIENIE I PROJEKTOWANIE ZŁOŻONYCH STRUKTUR  
PRZESTRZENNYCH

**Abstract**

Although the relationship between the cognitive style and creativity has been the subject of many studies, the results have been inconsistent. Therefore, it seems reasonable to further scrutinize the issue, particularly in the context of professionals, whose jobs involve creativity. The aim of the study was to determine the relationship between the need for cognitive closure and the level of creative and reproductive attitudes with the comprehension and design of complex spatial structures. The study involved 111 first-year students of Architecture at the Faculty of Architecture of the Cracow University of Technology. The results revealed that individuals with a low level of skills in design using geometric constructs had higher levels of reconstructive attitudes in the area of conformity and a lower level of the need for cognitive closure in the area of decisiveness than the ones with a high level of design skills, using geometric constructions. It was also found that as the level of the need for cognitive closure increased, the level of creative behaviour decreased; however, in participants with a high level of design skills using geometric constructions, it showed an upward trend. The results also indicated that the respondents held an average level of creative behaviour and a high level of conformity associated with a reproductive attitude, which is a worrying result as far as the future architects are concerned.

**Keywords:** creativity, need for cognitive closure, geometry, architecture

**Streszczenie**

Związki pomiędzy stylem poznawczym a twórczością są tematem wielu badań, jednak nie przyniosły one do tej pory spójnych rezultatów. Zasadne więc wydaje się dalsze analizowanie tego zagadnienia, zwłaszcza w odniesieniu do osób, których zawód w dużej mierze związany jest z szeroko rozumianą twórczością. Celem badania było określenie związków potrzeby poznawczego domknięcia i poziomu postaw twórczych oraz odtwórczych z rozumieniem i projektowaniem złożonych struktur przestrzennych. W badaniu wzięło udział 111 studentów pierwszego roku kierunku architektura Wydziału Architektury Politechniki Krakowskiej. Przeprowadzone analizy wykazały, że osoby o niskich umiejętnościach projektowania wykorzystującego konstrukcje geometryczne miały wyższy poziom postawy odtwórczej w obszarze konformizmu oraz niższy poziom potrzeby poznawczego domknięcia w obszarze zdecydowania niż osoby o wysokich umiejętnościach projektowania wykorzystującego konstrukcje geometryczne. Okazało się również, że u tych osób wraz ze wzrostem poziomu potrzeby poznawczego domknięcia zmniejszał się poziom zachowań twórczych, natomiast u osób o wysokim poziomie umiejętności projektowania wykorzystującego konstrukcje geometryczne miał tendencję wzrostową. Wyniki wskazują również, że wśród badanych dominował przeciętny poziom zachowań twórczych i wysoki poziom konformizmu związanego z postawą odtwórczą, co stanowi wynik niepokojący w odniesieniu do przyszłych architektów.

**Słowa kluczowe:** twórczość, potrzeba poznawczego domknięcia, geometria, architektura

## 1. Introduction

Creativity and the ability to comprehend and design complex spatial structures are essential skills for architects. At the same time, research on creativity show that only creative abilities may be insufficient if an individual does not possess appropriate personality traits [5]. Due to the fact that the findings concerning the links between creativity and personality traits, features of cognitive functioning, or environmental variables are inconsistent, there is a need for further exploration in this area.

## 2. Creative behaviour

Creativity invariably is associated with the production of unique works or ideas by prominent individuals. Nowadays, however, besides an elite approach to creativity, an egalitarian approach has been developing. In this approach, creativity is defined as a personal trait, which manifests itself in everyday life, and a creative individual is the one who shows an active attitude towards the reality, is open to change, solves problems creatively, and seeks to develop themselves, often by crossing their own borders [1, 18]. In the last decades, there have been many reports and publications concerning the characteristics of creative people, which included cognitive abilities, creativity, and personality traits [16]. Most of the developed models are interactive in character, that is, they take into account both personal, and socio-cultural aspects. Popek [19, 20, 21] proposed a model involving the concept of interactive creativity. According to Popek, creative abilities result from the interaction of the properties of an individual (cognitive, motivational and emotional) and environmental conditions (stimulation derived from the social environment, hierarchy of values). Popek [19, 20, 21] defines creativity as a cognitive and characterological property of an individual, which can be described on a continuum, with creative attitudes on the one end, and reproductive on the other. A creative attitude consists of heuristic behaviour (cognitive component) and nonconformity (characterological component) [20]. The reproductive attitude includes an algorithmic behaviour and conformity [20].

According to Popek [20], in the cognitive area, creative or heuristic behaviours are associated with the independence of observation, divergent thinking, logic memory, intellectual flexibility, reflexivity, creative imagination, constructive creativity, and a potential to develop an artistic creation [20]. The opposite to a heuristic behaviour is an algorithmic behaviour, which is associated with mechanical memory, reproductive imagination, directed perception, intellectual stiffness, convergent thinking, cognitive passivity, low level of reflection, low efficiency in processing and constructing, as well as the lack of artistic, or technical creativity [20].

From a characterological point of view, a creative attitude is related to nonconformity which is determined by independence, action, originality, consistency, courage, self-reliance, spontaneity, openness, perseverance, self-criticism, tolerance, expressiveness, and resistance [20]. In contrast to a creative attitude – the conformity is expressed through an adaptive stiffness, submission, stereotypes, dependence, fearfulness, defensiveness, low resistance, intolerance and lack of criticism [20].

A variety of research referred to the way creative individuals function. Bernacka [1], for instance, pointed out that creative nonconformists demonstrated a higher level of cognitive and creative needs, and more often were characterised by a heuristic behaviour. Research carried out by scientists from IPAR (Institute for Personality Assessment and Research) showed that creative people are independent, non-conformist, open to new experiences and not afraid of taking risks [23]. Malkiewicz and Piskozub's [17] study revealed that creative individuals were more task-oriented, and exhibited coping styles based on emotions than reproductive individuals. Similar results were obtained from Strzalecki's [25] study, who described a positive relationship between a creative behaviour and ability to overcome difficulties and obstacles.

In line with definitions of creative and reproductive attitudes, an architect should demonstrate a high intensity of heuristic behaviour and nonconformity, and a low intensity of algorithmic behaviour and conformity.

### **3. Need for Cognitive Closure (NfCC) and its relation to creativity**

The need for cognitive closure was first defined and described in order to explain individual differences in the context of cognitive functioning of individuals, who seek or acquired a relatively simple, factual knowledge in order to reduce their sense of insecurity.

Kruglanski [12, p. 6] defined the need for cognitive closure (NfCC) as a "desire for a firm answer to a question, any firm answer as compared to confusion and/or ambiguity." Two mechanisms underlie this need: the seize of information, and the freeze of information that has already been "caught" [13]. As a consequence, an individual does not need to cope with too much information, but only with the ones, which have been activated, or "seized" allowing them for as quick action. The transition from a "seize" to a "freeze" phrase initiates the crystallization of beliefs. At the same time, the "freeze" of information in the knowledge structures protects them against modification.

Individuals with high levels of NfCC strive for an immediate and consistent information closure [11, 14]. Thus, such people prefer a structured and predictable lifestyle, and avoid uncertainty and ambiguity [11], or cognitive complexity [26]. What is more, NfCC has been associated cognitive inhibition aiding individuals in coping with irrelevant information [10].

An overview of research on the need for cognitive closure conducted by Kossowska [8] showed that individuals with a high level of the need for cognitive closure, tend to reduce the scope of acquired data, and generate hypotheses, use the first available data and keep their opinion. These aspects are significant in the context of creative behaviour, but seem to stand in opposition to the need for cognitive closure, as they are linked to the search for new, surprising solutions and tolerance for ambiguity. Furthermore, a motivational aspect of creativity, involving the need for novelty and curiosity, opposes close-mindedness related to NfCC. Therefore, individuals with a high level of the need for cognitive closure are characterised by a lower intensity of creative behaviour, and contrary creative individuals-by lower intensity of need for cognitive closure. Jaworski [6] confirmed this notion; the students of artistic subjects scored lower on the scale of the need for cognitive closure than the other groups of students.

In contrast, Chybicka [3] pointed out that the need for closure is contextually determined and can affect the differences in creativity effectiveness, and in a proper contextual “opening” in individuals, NfCC does not inhibit creativity. Also, Sternberg [24] noticed that individuals, who prefer a cognitive style and pursuit goals according to settled standards and rules, can be also creative, due to the fact that some areas of their profession require various styles of thinking.

People, who aim at the quickest possible information closure and avoid uncertainty in novel and ambiguous situations, might feel uncomfortable, and as a result base their behaviour on previously developed ways of acting, and store information according to consistent and well-known schemata. Such behaviour contradicts the notion of creativity, being an essential condition for the process of architectural design. The need for cognitive closure may also manifest itself in difficulties to integrate a big amount of information. It might provide an explanation why people preferring a cognitive style experience more problems to integrate mathematical information [22], and cope with new, geometric construction tasks.

In order to understand the spatial structure of the complex geometrical construction, it is necessary to transfer it onto a drawing sheet. While solving geometric design tasks, it is impossible for students to only use their perceptual experience, but they are required to correctly read the projections of all elements of the space. They need to visualize the principles of projection of individual elements, which do not result from an intuitive, automatic processing of visual stimuli. People, who are exhibit a cognitive style, may also tend to oversimplify a mathematical and diminish geometric complexity, due to a shallow analysis of inflowing information [7]. This, in turn, can lead to irregularities in the integration of information and incorrect conclusions [22].

#### **4. The purpose of the study and hypotheses**

The purpose of the study was to identify relationships between the need of cognitive closure, the level of creative and reproductive attitudes and the comprehension and design of complex spatial structures. It has been assumed that people, who experience difficulty in the comprehension and design of complex spatial structures, exhibit a higher level of the need of cognitive closure and a higher level of reproductive behaviour than individuals who perform well on such tasks. It has also been asserted that the relationship between the need of cognitive closure and creative behaviour of individuals with different levels of abilities to understand and design complex spatial structures, differs.

### **5. Method**

#### **5.1. Participants**

The study involved 111 first-year students of Architecture at the Faculty of Architecture of the Cracow University of Technology. The sample consisted of 83 women and 28 men ( $M\text{-age} = 19.18$ ,  $SD = .79$ ).

## 5.2. Tools

Kossowska's [7] Polish adaptation of the Need for Closure Scale [15] was used in the study. The questionnaire consisted of 32 statements, each marked on a 6-point scale, ranging from 1 – *I strongly disagree* to 6 – *I strongly agree*. The scale was divided into five subscales: Desire for predictability (e.g. "I don't like to go into a situation without knowing what I can expect from it"), Preference for order and structure (e.g. "I think that having clear rules and order at work is essential for success"), Discomfort with ambiguity (e.g. "I'd rather know bad news than stay in a state of uncertainty"), Decisiveness (e.g. "I usually make important decisions quickly and confidently"), Close-mindedness (e.g. "I do not usually consult many different opinions before forming my own view"). A sum of all subscales indicated an overall level of NfCC.

In order to measure creative behaviour, the Creative Behaviour Questionnaire KANH [20] was used. It consisted of 60 statements, marked on a scale ranging from 0 to 2, where 0 indicated a false statement for the respondent, 1 – the statement was partially true, and 2 – the statement was true. The questionnaire was divided into four subscales. The scales of non-conformity (N) and the scale of heuristic behaviour (H) comprised the creative attitude, and the conformity scale (C) and algorithmic behaviour (A) comprised the reproductive attitude. The difference in the level of non-conformity and conformity referred to a characterological area of creative attitudes, while the difference in the level of heuristic and algorithmic behaviour – referred to a cognitive sphere of creative attitudes.

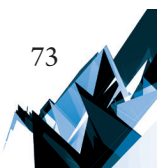
A geometric task was used to measure the comprehension and design skills of complex spatial structures. The principles of construction of a normal axonometric representation of an object, which is constructed based on its orthographic views, have been discussed within the lecture that presented the properties of a parallel projection method [4]. On the same day as the lecture, the students were supposed to construct an abnormal axonometric view of an object, but with taking no advantage of the notes which were taken by while listening to the presentation. The normal axonometric view was supposed to be constructed starting from the given two-view representation of an object presented in an orthographic projection method (Fig. 1).

Three various aspects of the solving procedure have been evaluated while checking the solutions and the obtained results. These were as follows:

1. Student's ability to correctly „read” and interpret the two-view drawing.
2. Ability to apply the construction of a normal axonometry by execution of the subsequent “steps of construction” that have been presented during the lecture:

Step 1: Assigning the segment  $X'Y'$  in the top view (EU method) – which is a horizontal trace of an axonometric picture plane; the triangle of traces  $X'Y'Z'$  must always be an acute-angled triangle whose heights determine the three directions of axonometric axes  $x^n$ ,  $y^n$  and  $z^n$ ;

Step 2: Assigning point  $M'$  on the line  $X'Y'$  as the base (= a starting point) of a vertical axonometric axis  $z^n$ . Point  $M'$  is a normal projection of  $O$  onto  $X'Y'$ ;



- Step 3: Determining the characteristic points of intersection between the sides of the object and the line  $X'Y'$ , which are the traces of the object's base on the trace  $X'Y'$ ; The axonometric view of the object's base will be drawn parallel to respective axes  $x'$  and  $y'$  through the determined points (I II  $x' 1, 2$  II  $y'$ );
- Step 4: Drawing a copy of the segment  $X'Y'$ , together with the assigned traces, in a separate space of a drawing;
- Step 5: As it has been mentioned above, the axonometric axes  $x^n, y^n$  and  $z^n$  are determined as the heights of an acute-angled triangle of traces  $X'Y'Z'$ , thus the axis  $z^n$  must be drawn perpendicular to  $X'Y'$  and starting from  $M'$ . The centre  $O^n$  of the axes  $x^n, y^n$  and  $z^n$  have to be chosen on  $z^n$  ( $O^nM^n$  is less than  $O'M'$ ). Directions of axes  $x^n$  and  $y^n$  are uniquely defined by  $x^n = O^nX'$  and  $y^n = O^nY'$ . The base of an object can be now easily constructed by drawing parallels to the axes  $x^n$  and  $y^n$  through the earlier determined traces on  $X'Y'$ ;
- Step 6: In order to determine the foreshortened heights of an object on the axis  $z^n$ , the rotation of the triangle  $Z'O^nY'$  must be executed. True heights of an object can be now measured on the rotated axis  $z^o$  and then transformed back (= rotated back) onto the axonometric axis  $z^n$ . The foreshortened heights will be used to add the heights to the base of a constructed axonometry.
3. Ability to correctly assign visible and hidden edges of a three-dimensional object by using either the thick continuous line (visible edges) or thin continuous lines (hidden edges).

Students who correctly performed two or three elements of the task were assigned to a group with a high level of design skills using geometric constructs, while those who managed only one element correctly or none, were assigned to a group with a low level of design skills using geometric constructs.

### 5.3. Procedure

The participants took part in a lecture on axonometry, and then performed a geometric task (without support of their own notes). A week after, the respondents were presented with the Need for Closure Scale and Creative Behaviour Questionnaire KANH.

### 5.4. Statistical analysis

The analyses were performed using (statistical analysis programs) STATISTICA 12 and SPSS 21. Leven's test was used to determine the homogeneity of variance. The t-test (in the absence of group homogeneity, the t-test was used with a separate estimation of variance) and the moderation analysis were used for comparisons between groups with low and high levels of geometric design skills. Pearson correlation analysis was used to analyse the relationship between the creative behaviour and the needs of cognitive closure. The significance level of  $\alpha = .05$  was assumed; however, the results for the significance level of  $\alpha = .10$  were also described as they fell within a limit considered as a trend ( $.05 < \alpha < .10$ ).

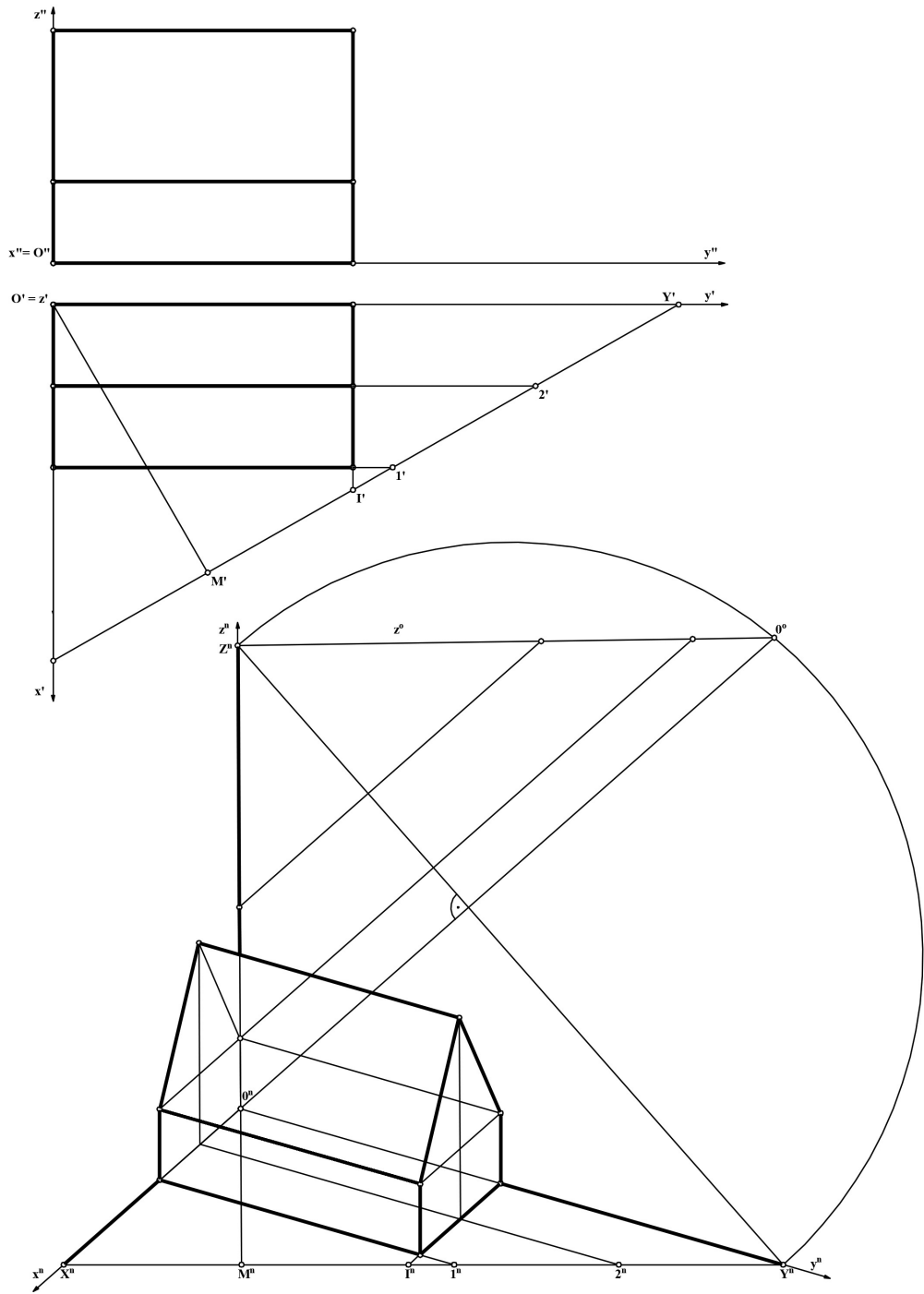


Fig. 1. Two views of a three-dimensional (3D) object together with a specified segment  $X'Y'$  where the axonometric picture plane cuts the horizontal picture plane and the normal axonometric image of the given in two views 3D object

## 6. Results

In order to determine whether the ability to comprehend and design complex spatial constructions was related to the level of the need of cognitive closure, the NfCC scores of students, who coped well and poorly with geometry task were compared (Tab. 1). It was observed that participants with a high level of design skills using geometric constructs showed a higher level of Decisiveness than students who performed a geometric task poorly, or not at all.

Table 1. Differences in level of the need of creative closure in individuals with low and high design skills using geometric constructs

	$M_{All}$	$SD_{All}$	$M_{GL}$	$M_{GH}$	$t$	$df$	$p$	$n_{GL}$	$n_{GH}$	$SD_{GL}$	$SD_{GH}$	$F_L$	$p_L$
Discomfort with ambiguity	26.42	3.20	26.38	26.41	-.03	108	.974	78	32	3.16	3.33	1.11	.700
Preference for order and structure	28.57	5.90	28.68	28.34	.27	108	.789	78	32	6.05	5.72	1.12	.745
Desire for predictability	29.14	5.90	28.59	30.50	-1.55	108	.125	78	32	6.09	5.35	1.30	.423
Close-mindedness	16.37	3.27	16.38	16.34	.06	108	.953	78	32	3.53	2.65	1.78	.075
Decisiveness	17.11	4.35	16.53	18.38	-2.42	85.24	.018	78	32	4.67	3.12	2.24	.014
NfCC	117.60	13.58	116.56	119.97	-1.19	108	.236	78	32	14.04	12.47	1.27	.467

$p$ :  $p$ -value

GL: low level of design skills using geometric constructs

GH: high level of design skills using geometric constructs

NfCC: Need for Cognitive Closure

$F_L$  and  $p_L$ : Leven's test of homogeneity

The measurement of creative behaviour, and transformation of the results onto a stenographic scale to derive the values of the general population, showed that in the examined group of future architects, only the level of conformity exceeded the average level for the population (7 sten); other results, also those related to the creativity, were exactly at the average level for the population (Tab. 2). In order to determine whether these traits were related to the handling of geometric constructions, the level of traits in participants who performed the geometric task well was compared with the level of traits in individuals who performed the geometric task poorly (Tab. 3). The comparison indicated that participants who did the geometric task well had a lower level of conformity than individuals who performed poorly, or not at all ( $p = .056$ ). The other differences were statistically insignificant.



Table 2. The level of creative behaviour

	<i>n</i>	<i>M</i>	<i>SD</i>	<i>Min</i>	<i>Max</i>	<i>Sten (median)</i>
Conformity	110	12.50	4.21	4.00	22.00	7
Nonconformity	110	18.30	4.18	8.00	27.00	5
Algorithmic	110	13.52	2.99	7.00	23.00	5
Heuristic	110	17.97	3.59	10.00	26.00	5
Creative	110	36.27	7.02	20.00	52.00	-
Reproductive	110	26.02	6.16	13.00	41.00	-
SphereCH	110	5.80	6.62	-12.00	20.00	5
SphereP	110	4.45	4.92	-10.00	16.00	6

SphereCH: Characterological Sphere

SphereP: Cognitive Sphere

Table 3. Differences in levels of creative behaviour among individuals with a low and high level of design skills using geometric constructs

	<i>M<sub>GL</sub></i>	<i>M<sub>GH</sub></i>	<i>t</i>	<i>df</i>	<i>p</i>	<i>n<sub>GL</sub></i>	<i>n<sub>GH</sub></i>	<i>SD<sub>GL</sub></i>	<i>SD<sub>GH</sub></i>	<i>F-Var</i>	<i>p-Var</i>
Conformity	13.05	11.38	1.93	107	.056	77	32	3.97	4.50	1.28	.381
Nonconformity	18.25	18.63	-.43	107	.667	77	32	4.25	3.95	1.16	.659
Algorithmic	13.53	13.56	-.05	107	.962	77	32	3.19	2.49	1.64	.124
Heuristic	17.81	18.38	-.75	107	.455	77	32	3.65	3.53	1.07	.855
Creative	36.05	37.00	-.64	107	.523	77	32	7.13	6.82	1.10	.798
Reproductive	26.58	24.94	1.28	107	.203	77	32	6.17	5.97	1.07	.858
SphereCH	5.19	7.25	-1.48	107	.143	77	32	6.76	6.26	1.17	.646
SphereP	4.27	4.81	-.52	107	.606	77	32	5.24	4.18	1.58	.159

*p*: *p*-value

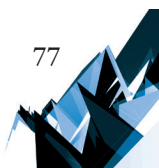
SphereCH: Characterological Sphere

SphereP: Cognitive Sphere

GL: low level of design skills using geometric constructs

GH: high level of design skills using geometric constructs

Several relationships between the level of creative behaviour and the need for cognitive closure were observed in the sample (Tab. 4), for instance, the higher the level of Preference for order and structure was, the higher the level of Non-Conformity, Heuristic behaviour, Algorithmic behaviour, as well as the global level of creative and reproductive attitudes became. As the level of Preference for predictability increased, the level of Conformity, Algorithmic behaviour and reproductive attitudes also increased, but the level of Nonconformist characterological attitude decreased. What is more, as the level of Decisiveness increased, the level of Non-conformity, creative attitude and the level of non-conformity sphere of characterological creative attitude increased, but the level of Conformity decreased. It was also observed that the higher the level of Close-mindedness, the lower the overall levels of creative attitude, heuristic thinking, Non-conformity and cognitive and characterological sphere of creative attitude. The analyses also showed that as the general level of the need for



cognitive closure increased, the level of Algorithmic behaviour and reproductive attitudes increased, but the level of the cognitive sphere of creative attitude decreased.

Table 4. The relationship between the need for cognitive closure and the level of creative behaviour

	Discomfort with ambiguity		Preference for order and structure		Desire for predictability		Close-mindedness		Decisiveness		NfCC	
	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>	<i>r</i>	<i>p</i>
Conformity	.08	.383	.06	.536	<b>.23</b>	<b>.014</b>	.01	.910	<b>-.20</b>	<b>.039</b>	.09	.367
Non-Conformity	-.13	.171	<b>.19</b>	<b>.042</b>	-.15	.111	<b>-.26</b>	<b>.006</b>	<b>.31</b>	<b>.001</b>	.03	.782
Algorithmic	.02	.857	<b>.34</b>	<b>&lt;.001</b>	<b>.18</b>	<b>.064</b>	.09	.349	.09	.330	.28	.003
Heuristic	-.04	.670	<b>.20</b>	<b>.039</b>	-.07	.485	<b>-.38</b>	<b>&lt;.001</b>	.16	.095	.01	.923
Creative	-.10	.302	<b>.22</b>	<b>.023</b>	-.12	.191	<b>-.35</b>	<b>&lt;.001</b>	<b>.27</b>	<b>.005</b>	.02	.830
Reproductive	.07	.494	<b>.21</b>	<b>.031</b>	<b>.24</b>	<b>.010</b>	.05	.596	-.09	.355	.20	.039
SphereCH	-.14	.155	.08	.379	<b>-.24</b>	<b>.010</b>	<b>-.17</b>	<b>.076</b>	<b>.32</b>	.001	-.04	.691
SphereP	-.04	.675	-.06	.509	-.16	.103	<b>-.33</b>	<b>&lt;.001</b>	.06	.535	-.17	.083

*p*: *p*-value

SphereCH: Characterological Sphere

SphereP: Cognitive Sphere

NfCC: Need for Cognitive Closure

It was also examined whether the relationship between the need for cognitive closure and creative behaviour were differentiated by the level of ability to comprehend and design of complex spatial structures, i.e. whether relationship between NfCC and creative behaviour would differ in participants with a low level of design skills using geometric constructs, and those with a high level of design skills using geometric constructs (Tab. 5).

Table 5. Differences in types of relationship between the need for cognitive closure and creative behaviour in participants with a low and high level of design skills using geometric constructions (Moderator: the level of ability to comprehend and design of complex spatial structures GH vs GL)

Predictor	Dependent variable	$\beta$	SE	<i>t</i>	<i>p</i>	Interaction
1	2	3	4	5	6	7
Decisiveness	SphereP	.13	.11	1.19	.238	
	SphereCH	.08	.11	.72	.475	
	Heuristic	.09	.11	.79	.432	
	Algorithmic	-.11	.11	-1.02	.311	
	Non-Conformity	-.02	.11	-.22	.826	
	Conformity	-.14	.11	-1.33	.187	
	Creative	.03	.11	.29	.774	
Reproductive	-.15	.11	-1.39	.168		

1	2	3	4	5	6	7
Close-mindedness	SphereP	.08	.10	.80	.426	
	SphereCH	.05	.11	.51	.613	
	Heuristic	.11	.10	1.07	.287	
	Algorithmic	-.01	.11	-.05	.976	
	Non-Conformity	.08	.10	.79	.430	
	Conformity	-.003	.11	-.03	.976	
	Creative	.10	.10	1.03	.307	
	Reproductive	-.005	.11	-.05	.962	
Preference for order and structure	SphereP	-.14	.10	-1.20	.232	
	SphereCH	.02	.11	.22	.829	
	Heuristic	-.18	.10	-1.62	.109	
	Algorithmic	.10	.11	.09	.930	
	Non-Conformity	-.06	.11	-.52	.605	
	Conformity	-.01	.11	-.86	.391	
	Creative	-.13	.11	-1.14	.258	
	Reproductive	-.06	.11	-.55	.583	
Desire for predictability	SphereP	.09	.11	.85	.399	
	SphereCH	.21	.11	<b>1.96</b>	<b>.052</b>	$\beta$ GL = <b>-.37</b> ( $p = .001$ ) $\beta$ GH = <b>.05</b> ( $p = .795$ )
	Heuristic	.04	.11	.39	.695	
	Algorithmic	-.10	.11	-.92	.359	
	Non-Conformity	.12	.11	1.07	.285	
	Conformity	<b>-.21</b>	<b>.11</b>	<b>-2.02</b>	<b>.046</b>	$\beta$ GL = <b>.37</b> ( $p = .001$ ) $\beta$ GH = <b>-.06</b> ( $p = .741$ )
	Creative	.09	.11	.84	.405	
	Reproductive	-.20	.11	-1.03	.071	$\beta$ GL = <b>.36</b> ( $p = .001$ ) $\beta$ GH = <b>-.03</b> ( $p = .868$ )
Discomfort with ambiguity	SphereP	.07	.12	.60	.552	
	SphereCH	<b>.23</b>	<b>.11</b>	<b>2.04</b>	<b>.044</b>	$\beta$ GL = <b>-.27</b> ( $p = .021$ ) $\beta$ GH = <b>.15</b> ( $p = .381$ )
	Heuristic	.02	.12	.22	.829	
	Algorithmic	-.08	.12	-.72	.471	
	Non-Conformity	<b>.24</b>	<b>.11</b>	<b>2.11</b>	<b>.037</b>	$\beta$ GL = <b>-.25</b> ( $p = .029$ ) $\beta$ GH = <b>.18</b> ( $p = .289$ )
	Conformity	-.13	.11	-1.11	.270	
	Creative	.16	.12	1.34	.182	
	Reproductive	-.13	.11	-1.11	.171	

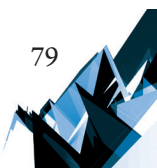


Table 5 (cont.)

1	2	3	4	5	6	7
NfCC	SphereP	.06	.11	.51	.608	
	SphereCH	.17	.11	1.53	.129	
	Heuristic	-.003	.11	-.03	.979	
	Algorithmic	-.10	.11	-.91	.365	
	Non-Conformity	.08	.11	.71	.479	
	Conformity	<b>-.19</b>	<b>.11</b>	<b>-1.74</b>	<b>.085</b>	$\beta_{GL} = .21 (p = .059)$ $\beta_{GH} = -.17 (p = .368)$
	Creative	.05	.11	.41	.686	
	Reproductive	-.18	.11	-1.64	.104	

*p*: *p*-value

SphereCH: Characterological Sphere

SphereP: Cognitive Sphere

GL: low level of design skills using geometric constructs

GH: high level of design skills using geometric constructs

The results indicated that in the case of the relationship between Desire for predictability and creative behaviour in the participants with a low level of design skills using geometric, the level of Desire for predictability increased, as the level reproductive attitude, and Conformity increased, but the level of Characterological Sphere associated with creativity decreased. However, in the individuals who performed well on geometric constructions design, the relationship was reversed, though statistically insignificant. As far as the relationship between Discomfort with ambiguity and creative behaviour is concerned, it was observed that as the level of Discomfort with ambiguity increased, the level of nonconformity and entire sphere of characterological creativity decreased in the group of the respondents with a low level of design skills, whilst the relationship was reversed among the respondents with a high level of design skills using geometric construct, but it was statistically insignificant. Additionally, it was found that as the general level of NfCC increased, the level of Conformity rose in participants who performed poorly on the geometric task; however, the relationship was reversed among respondents who performed well on the geometric task, but statistically insignificant.

## 7. Discussion

The results showed that creative behaviour and the need for cognitive closure are closely linked; however, the direction of the relationship may be different depending on individual's level of design skills using geometric construct. The increase in the need for cognitive closure (desire for predictability, discomfort with ambiguity, and general level of NfCC) was associated with lower levels of creative behaviour and a higher level of reproductive behaviour in the group, who performed poorly on the geometric task. However, in the group of the respondents with a high level of design skills using geometric constructs, the direction was reversed, but statistically

insignificant. This may indicate that for individuals, who are able to adequately visualize, even complicated geometric constructions, the inhibition of creative behaviour does not occur, even at a higher level of the need of cognitive closure. Perhaps, in case of such individuals, the lack of discomfort with ambiguity facilitates the ordering of information according to one's own rules and not in a way enforced by others, which in turn promotes comprehension of complex spatial forms.

Also, the results concerning the relationship between the creative attitude and the need for cognitive closure seem to be interesting. It was found that the higher the intensity of Preference for order and structure was, the higher the level of creative behaviour occurred in the sample. This confirms the notion that in the case of individuals, who design new architectural forms, i.e. their activity is creativity-related, the realization of the task requires not only order and decisiveness, but besides artistic form, also technical and engineering skills.

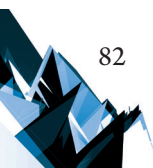
The analyses showed that individuals with a higher level of design skills using geometric construct, also exhibited a higher level of decisiveness than individuals who performed poorly on geometric task. What is more, they presented a lower level of conformity. As far as the analysis of moderators is concerned, it is uncertain whether the characterological sphere of creativity is the most important here. Perhaps, as for construction tasks, they strive for order and predictability combined with a nonconformity, may enhance students' comprehension and solution finding. The low level of conformity might be necessary for architects to create rules and manage the design process on a two-dimensional surface, without having to rely on third parties.

Nevertheless, the findings concerning the level of creative and reproductive attitudes among surveyed students – the future architects seem alarming. None of the elements of creative attitude exceeded the average level for the population; however, a slightly higher than an average score was found in the intensity of conformity. Taking into account an earlier discussion of the link between the ability to comprehend and design geometrical constructs, and a low level of conformity, a serious concern arises as far as students' suitability for the profession of architect is concerned. The study of Wojtowicz and Wojtowicz [27] sheds a positive light on the problem. The results revealed that the grade obtained by students from an architectural design task was not significantly associated with the level of implementation of the geometric task. Nonetheless, the average level of heuristic behaviour, nonconformity, as well as the cognitive and characterological sphere of creative attitudes might reduce the future chances of pursuing architectural designs, which could, in some way, be indeed visionary. Even though architecture involves a conscious shaping of space to achieve its intended function in a well-defined form and structure [2], people who base on well-known and proven schemes only may end up with monotony and mediocrity on the subject of architecture.

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