The analytical psychology of architecture

between subjective expression and objective meaning

Piotr Anusiewicz[1], Andrzej Chmiel[1,2], Elżbieta Grodzka[1], Maria Kuc[1],
Marta Maliszewska[1], Ewa Pol[1], Piotr Szymański[1]
Authors listed in alphabetical order of surnames

[1] Interfacultative Research Group for Psychology and Art – Expression (pol. Ekspresja), Wrocław University of Technology, ekspresja@pwr.wroc.pl, http://www.ekspresja.pwr.wroc.pl
[2] Department of Education, Faculty of Education, University of Lower Silesia

Abstract: The paper outlines the theoretical framework for the concept of applying analytical psychology to architectural design. What has been discussed are methods and process of designing tools for the analysis of perceptual experiences resulting from the representations of the notions used in the description of the architectural space attributes. A tool is presented – pictogram test based on the graphic reduction of the language of architecture as well as environmental research results confirming its accuracy. The presented methods of analysis concern pictograms as well as perceptual experience presumption errors in the design process. The errors a designer unwary of the complexity of the perceptual experience of the designed architectural space could be prone to have also been identified.

Keywords: analytical psychology of architecture, architecture perception, design process

The presented paper demonstrates the results of three years of research under the Analytic Psychology of Architecture project supervised by Andrzej Chmiel within the Interfacultative Research Group for Psychology and Art – Expression (pol. Ekspresja) at Wrocław University of Technology. Research has been initiated by Andrzej Chmiel at one of his seminar's with a following postulate:

"Both in psychology and architecture the most important question is: "whom is the man?". These sciences can inspire each other; create hypotheses and models of their resolution. From that peculiar transcription, that community of thought and reciprocity of inspiration emerges my understanding of and the need to introduce the analytic psychology of architecture with its categories extracted from C.G. Jung's theory, such as extra or introversion, and understood not so much in the context of behaviour or reactiveness, i.e. what the environmental psychology pursues,

but in categories predominant to behaviour – the categories of perception and orientation that not only account for the orientation of energy, but also the psychic functions pointed by Jung. (JUNG, 1997)"

The above outlined idea for a psychological approach to the process of designing architectural space has become fundamental to our further considerations – to understand the patterns of the human experience of architecture and their analytic grounds based on Jung's theory and his categories of the interaction with the outside world. Having set this theoretical concept against the professional practice in the field of architecture of the paper authors has revealed the target need to create an architectural space design method that is in accord with a human psychological type. That field of research has been explored starting from a closer examination of perception's role in the human interaction with architecture.

The relations between the psyche and architecture have also been sought for by the architects, incl. Juliusz Żórawski, who was the first to initiate the direction of research on the "detailed interpretations of art from the point of the human psychosomatic construction" (BOHDAN, 1973, p. 7), as well as the art theoretician Rudolf Arnheim, who claimed a few years later that „looking at the world requires mutual cooperation between the properties of the object and the nature of the subject" (ARNHEIM, 1978, p. 19).

Both of them have rested on the visual perception not understood as a passive process of reality recording, but as its active reception through capture and comprehension of its essential features. Perception creates perceptual notions related to the general characteristic of the structure, e.g. asymmetry, and generates psychological impression – perceptual experience. The definition of perception as understood by Arnheim has been used for further research.

The first stage of creating a design method for human psychological type-compatible architectural space has shown a necessity to prepare a test based on an uncomplicated graphical motif, which could serve as a translator of perceptual experiences into geometrical forms and the other way round.

The test is composed of pictograms imitating the nature of the visual experience by means of an established structural theme (DONDIS, 1973), i.e. a flat arrangement of lines composed of black lines on a white background. Each pictogram transforms the theme in such a way that a given perceptual notion is illustrated best. The architecture has been reduced to flat forms on purpose, so that the methodological character of the arguments, which can be related to a two-, as well as three-dimensional geometry, could be emphasized by the homogeneity of the adopted structural subject. Such an approach seems right because, as J. Żórawski wrote: „even the most intricate issue is easier explained by means of a simple diagram and there is always a possibility to transform a flat drawing into a three-dimensional space" (ŻÓRAWSKI, 1973, p. 20).

For the test to take shape it was first necessary to identify the notions of the language of architecture which could translate into perceptual notions capable of describing the architectural form. Like Żórawski did (ŻÓRAWSKI, 1973, p. 15-16), the aspects of function and structure have been intentionally omitted as elements of less importance in the initial reception. After the first iteration of works, impossible to be given a thorough description in the paper's abstract, the final list of perceptual notions devoid of excessive complexity and at the same time too general a character has been generated. The final graphic version of the test enclosed sixteen boards measuring 45x45 cm. Each board depicted one of the following perceptual notions: rhythmic, static, open, symmetric, ordered, empty, convex, light, arrhythmic, dynamic, close, asymmetric, chaotic, full, concave.

The adopted set of notions needs to be treated as contractual. It is based on the aspects resulting from geometric attributes of the architectural form. The elements related to lighting, color, or texture have been omitted.

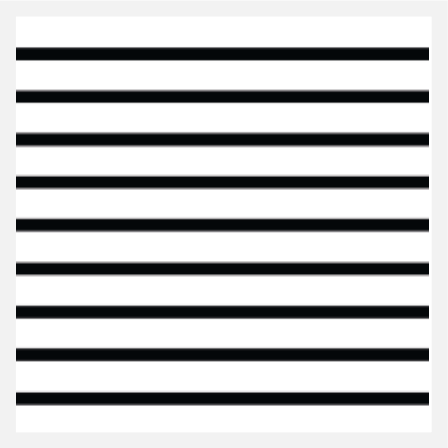
The next stage of the work was to create a test and verify its semantic accuracy, i.e. check whether the created graphic reductions were clearly interpreted as assumed perceptual notions. In other words, whether the *empty* pictogram matches the perceptual notion indicating emptiness in the architectural space. Positive verification of the test's semantic accuracy would allow to use it as an element representing perceptual experiences in a later test that analyzes the preferences of a recipient of the architectural space.

In order to verify the semantic accuracy of the test's final draft four environmental studies have been conducted during the period June to December 2010, directed to respondent groups of various background in architecture and arts. In total, 434 participants, 230 architects, 205 non-architects have been studied.

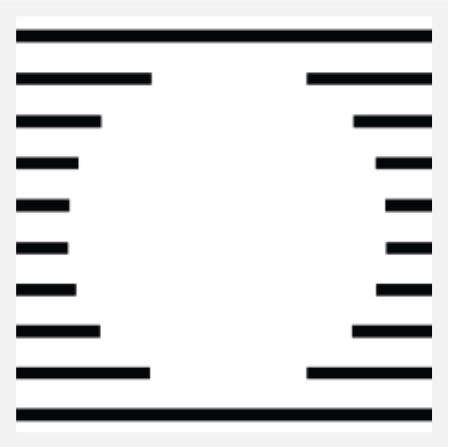
In the first environmental study each participant has been given a set of 16 notions and has been asked to assign each notion to a given pictogram which he or she believed illustrated a given notion best.

In every following study either of the two variants of a set incorporating 8 notions was given to the participants instead of all the 16:

- variant A: static, empty, light, ordered, rhythmic, symmetric, open, convex
- variant B: dynamic, heavy, chaotic, asymmetric, arrhythmic, close, concave

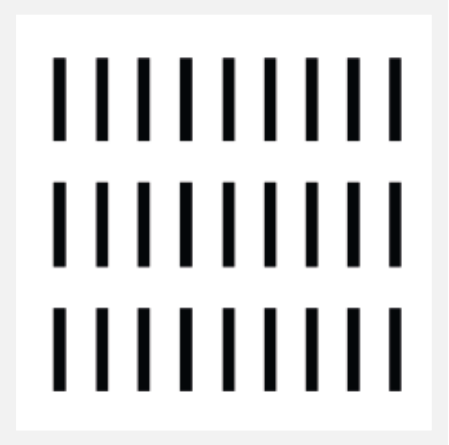


static

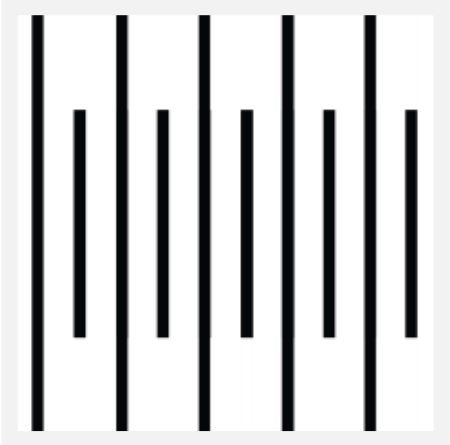


empty

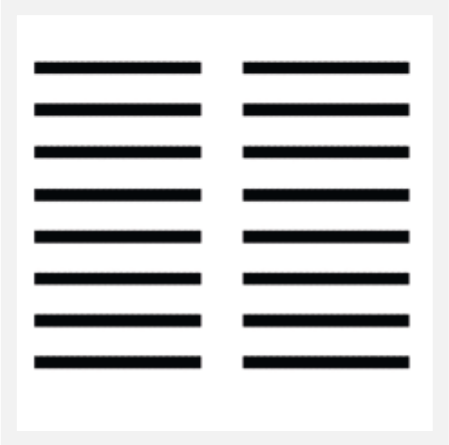
light



ordered



rhytmic

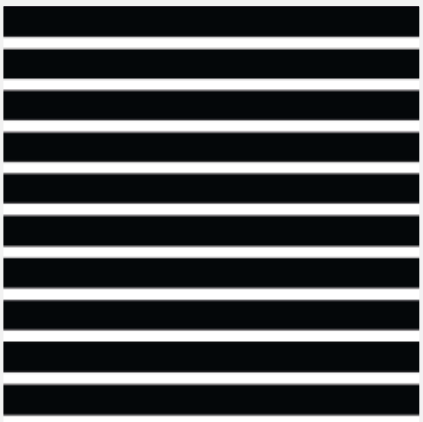


symmetric

convex

open

dynamic

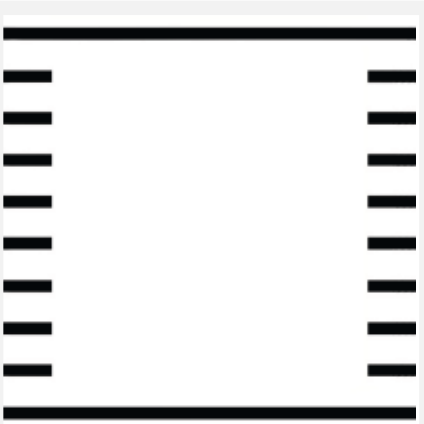


heavy

chaotic

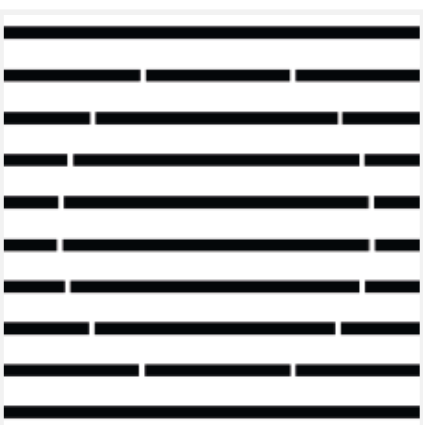
assymetric

arrhytmic



close

concave



full

The variants have been set in a way that the notions of the A variant be antonyms of the notions of the B variant. Thus, the participants have been prevented from comparing the pictograms by means of perceptual notion pairs. They have been then asked to assign each notion to a given pictogram, which they believe is best at illustrating a given notion. A container marked as *waste* has been introduced in the following studies, intended for any perceptual notions that the participants could not assign to any of the pictograms.

The first element of the semantic accuracy are accessibility and perceptual recognizability of a pictogram measured with the index of correct votes, i.e. the votes that prove the pictogram to effectively represent the perceptual notion it has been designed for. On that basis it is possible to measure what per-cent of respondents experienced the correct perceptual experience following the interaction with a given pictogram.

The second element of assessing a pictogram's semantic accuracy is its lack of notional absorption measured with the corresponding perceptual notion's index of the votes unassigned to any pictogram. It is thus that the percentage information is obtained on how perceptually inaccessible the said pictogram is.

The third element of assessing the semantic accuracy is a given pictogram's entropy. It informs us how large the certainty loss of the pictogram as an information carrier is. It also provides knowledge on the perceptual experience spectrum the given pictogram evokes. The entropic model is defined as follows:

For a given pictogram p:

Let X_p be a random variable with possible values $\{t_1, \dots, t_{16}\}$, i.e. a set of selected perceptual notions.

Probability that the variable X_p takes the value t_i is equal to the percentage share of a perceptual notion i among the perceptual notions assigned to a pictogram $p_i = \Pr\{X_p = t_i\} = \frac{amount\ of\ perceptual\ notions\ i\ cast\ for\ pictogram\ p}{the\ total\ amount\ of\ perceptual\ notions\ cast\ for\ pictogram\ p}$.

Entropy is defined as follows (COVER e THOMAS, 2006, p. 14):

$$H(X_p) = \sum_{i=1}^{16} p_i \log \frac{1}{p_i}$$

Zero entropy indicates a perfectly unequivocal pictogram, identical to one of the perceptual notions (not necessarily correct, but fixed one). Entropy is a function increasing with the probability distribution to X_p approaching the uniform distribution (COVER e THOMAS, 2006, p. 29). The maximum value of entropy is reached at uniform distribution, i.e. when a pictogram *p* has exactly the same percentage share of every perceptual notion. Then entropy equals $\log 16 \cong 1.2$ and indicates that the pictogram is fully ambiguous.

The fourth element of assessing the semantic accuracy is a pictogram's internal contradiction level measured with the index of votes for a perceptual notion opposite to the one the pictogram has been intended to depict.

The most semantically accurate pictogram was *chaotic* with the highest - 50% perceptual accessibility, highest perceptual absorption at 66%, lowest entropy – 0.69, relative informational uncertainty at 57% and zero internal contradiction. *Chaotic* pictogram is correctly recognized by architects (49%) as well as non-architects (51%). This means that half of the subjects has perceptually experienced *chaotic* pictogram as *chaotic* with a simultaneously high concentration of voices. *Chaotic* was mistaken with the following perceptual notions most: arrhythmic (14%) and dynamic (12%).

Since the beginning of the semantic accuracy study of the test there have been emerging significant differences between perceptual experience of architects and non-architects. The performed studies have shown that non-architects have definitely more often been assigning perceptual notions to pictograms incorrectly. This phenomenon is most visible in the case of *light* pictogram (30% more mistakes made by non-architects), as well as with *rhythmic* (20%), *concave* and *convex* (16%), *symmetric* (15%). Non-architects have been assigning the perceptual notions to pictograms with a higher percentage of mistakes than architects, excluding the pictograms *open*, *full*, *heavy*, *chaotic*.

With the following result it is necessary to stress the significant role of the error in the design process. The *open* pictogram has been constructed on the basis of the concept of an analogy to an open zipper, which could illustrate the notion of openness. Such emergent inconsistency is a common element of the architecture design process – constructing on the basis of a conscious building of the perceptual experience becomes constructing based on the analogy. Such a replacement is moreover often prone to occur unconsciously in the designer's mind. That it is erroneous to make such a link, which associates thinking by means of analogy and perceptual experience through analogy and presumption of one's translation into another, has only been a hypothesis during research. It is thus, that despite the awareness of that replacement, it has not been decided to redesign the pictogram.

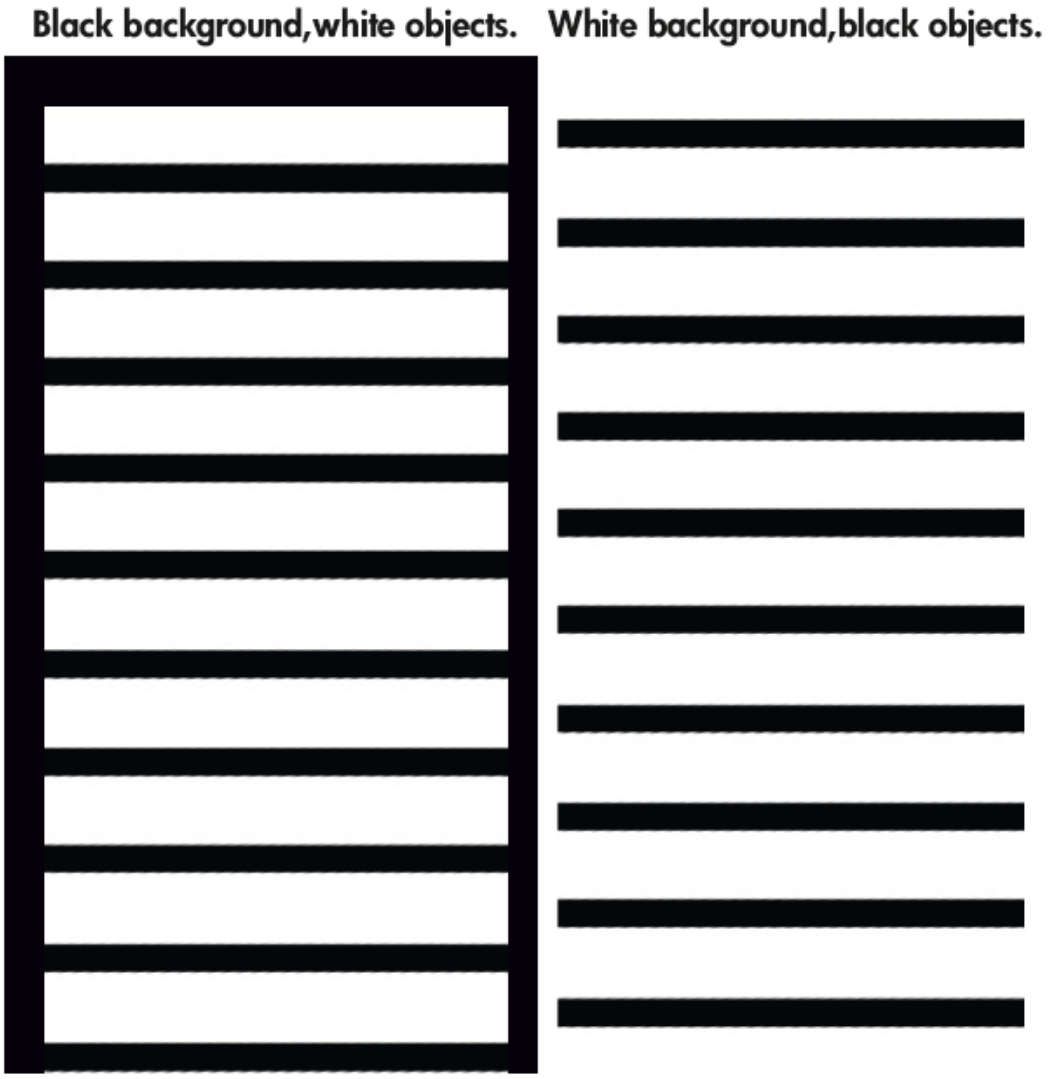
That mistake manifests itself in the lowest perceptual recognizability of the pictogram first – only 13%, a high level of internal contradiction – 13% of participants have assumed that it represents the perceptual notion of *close*. That mistake is also visible in the fact that the votes for it have been distributed almost evenly between all the available perceptual notions, which means that the *open* pictogram is characterized by the largest entropy (1.0) – its relative uncertainty as an information carrier reaches thus 83%. At the same time it is the only pictogram that the non-architects have 13% more often perceptually experienced correctly than the architects.

The pictogram also outlines the problems which can emerge during an architect's design process of the architectural space on the basis of a non-architect's psychological type. That is the reason for the choice of the pictogram to conduct a model analysis of the perceptual experience error in light of Arnheim's theory. This also indicates that to err is a creative element of the design process, since the design of a pictogram is also a design, and reaching the essence of the assumption error through that observation is worth consideration.

The representation of the pictogram is made of 20 black rectangles grouped in two analogous vertically arranged groups, shifted relatively to each other along the central vertical axis. Reading the whole pictogram from the lower left to the upper right, and the from the upper left to the lower right there is no apparent distortion of equilibrium of the whole representational form (as defined in (ARNHEIM, 1978, p. 46)).

On the basis of the shape a beholder can describe objects or images. Yet, every such an object possesses a form, which is the content perceived through the lens of the shape. Only in the case of the formal analysis we are allowed to separate shape from what it denotes (ARNHEIM, 1978, p. 106). Form, which exceeds the boundaries of shape and practical function, allows for free identification and recognition of the additional attributes of an object related to its content. Therefore, human beings can distinguish partial images of things because of the known content and independently whether it is associated with real objects or a collection of abstract notions.

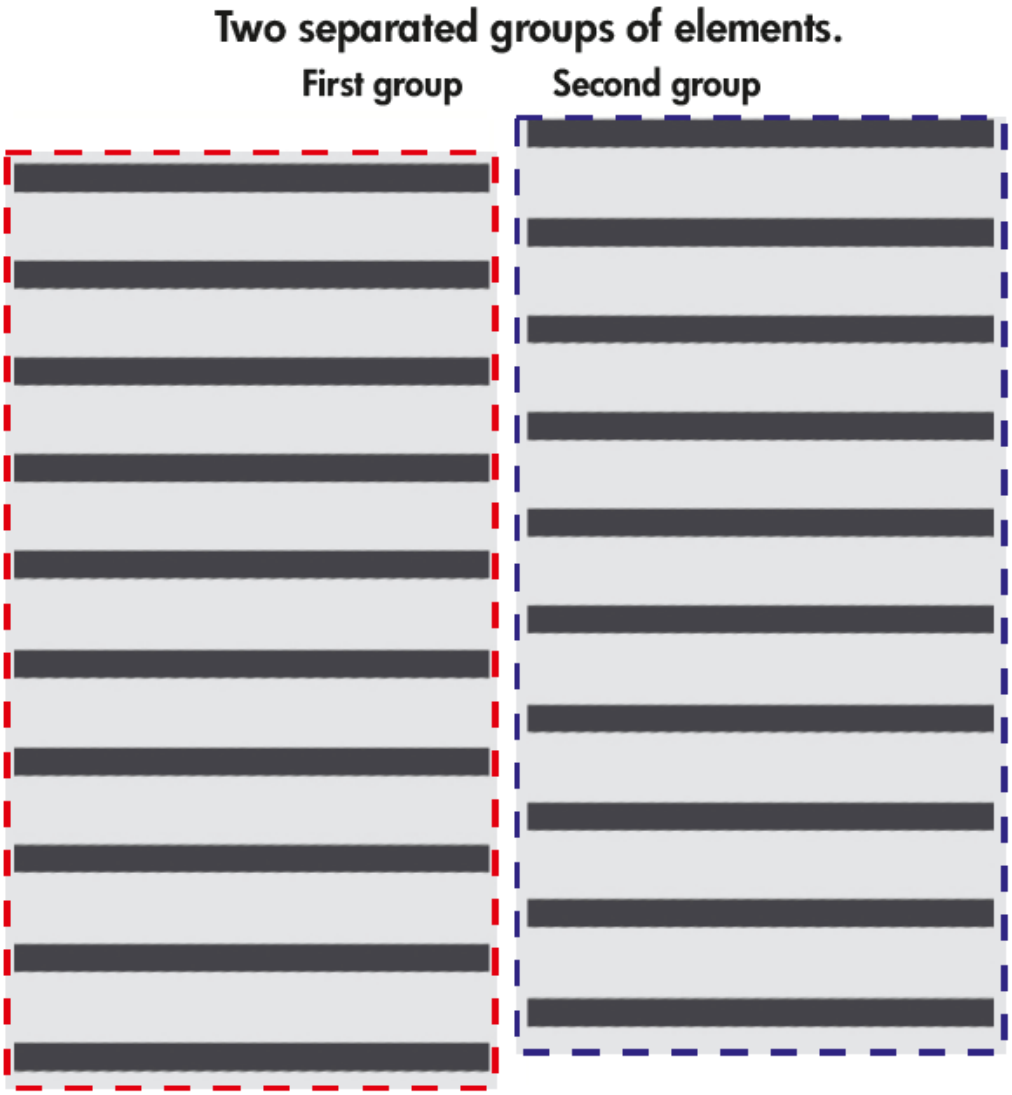
The *open* pictogram consists of two planes, represented by white and black areas. The two rules of Edgar Rubin (ARNHEIM, 1978, p. 232-233) suggest that the white area constitutes the background, while the white one the figure. According to the first, the human mind "is inclined to perceive the encircled area as the figure, whereas the encircling, limitless area as the background". Admittedly, as for the *open* pictogram, the black figure is not entirely encircled, but the second Rubin's rule indicates, that as the figure we see the relatively smaller area – and the domination of the white area over the black is visible. The pictogram's form points to such an interpretation because the white area made up by the white spaces between the lines and the white line that separates them clearly dominate in volume the area of the two rows of black lines, that are shifted relative to each other.



Furthermore, the black as well as the white space contact the edges of the pictogram. However, the relation resulting from the second law allows for the relation described by the first to eventually occur – the white background seems limitless, while the black lines seem to end just by the edge of the pictogram. Thus, the reverse of the whole situation, where the white space would be perceived as a homogeneous figure, and the black lines as a partially visible background, does not seem default in light of the aforementioned rules.

Then, the law of simplicity assumes that “when a combination results in a figure simpler than what would be given by an ordinary sum of separate lines – we will see one integrated whole” (ARNHEIM, 1978, p. 224). The black lines in the pictogram, each one of which could be

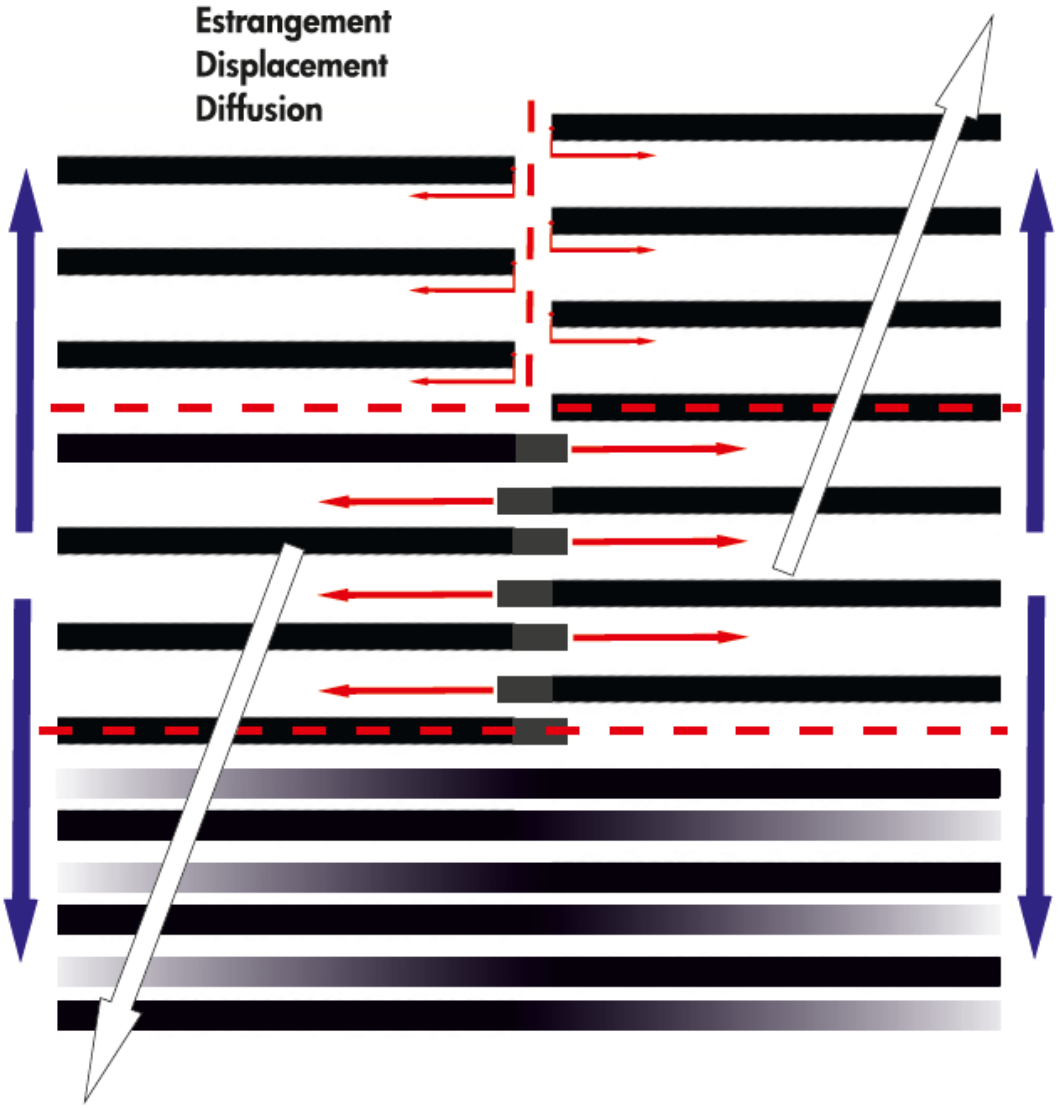
considered a figure, are linked by the fact that they possess a common plane, which causes them to be perceived as positioned in front of the background, as a de facto single figure. The phenomenon makes it possible for them to be analyzed as a sum – a collection of elements related to each other, but physically separate.



The classification of objects as sum does not mean that one can perceive them as a single, integrated element. The law of simplicity does not allow for such an occurrence because the required economical advantage of such a merging does not take place in the pictogram and each line remains separate. In other words, we discuss a default figure, which is made of the sum of many elements, not one, because a possible single element that is a merge of all the lines is not simpler than their sum.

An alternative interpretation of the figure plane of the pictogram would be an attempt to point, that the black lines do not indeed constitute a single complex element, but do not constitute a sum of separate simple elements either. What they do instead is constitute something intermediate, a sum

of two complex elements, two vertical rows, which are formed by horizontal lines in both of them. Both interpretations assume, however, that the single element figure is not a default reading for the perception of the pictogram under discussion.



This raises the question whether the default way of reading the character of the figure matters in any way to finding the correct meaning of the pictogram. According to Arnheim's theory three methods of reading the figure are possible: a complex, one-element form; a complex, two-element form; a multi-element sum form. Therefore, any non-neutral influence of each of the possible methods of reading on the test result would give an answer to the question which of them promotes the perception of the desirable pattern through the observation of the representational notion. The perception of that notion would in turn induce the desired perceptual notion of "openness".

Because of them being perceptually default we could expect that it is the two- or multi-element forms (or both) that have a decisive impact on the lack of perception of the perceptual notion of openness during contact with the discussed pictogram, and consequently lack of the perceptual experience of openness.

What could prove helpful for such a reasoning is finding arguments that support the idea that only the two- or multi-element form promotes the comprehension of the construction of the pictogram as analogy. Hence, a given form would have to be logically related to the perceptual notion of openness. Recalling the process of constructing form for the perceptual notion of that pictogram, the associations with a “zipper” being opened must be recalled. This is supposed to be suggested by the horizontal rows of two lines each shifted relative to each other. That is supposed to make an impression of movement, so the lines to the right would overlap with those to the left like a closing zipper. Such a relation requires the perceiver to activate thinking by means of analogy. There is a possibility that to raise the probability for a perceiver to observe such a correlation it is necessary for one to regard a figure as a formation being in the process of “opening”. The generation of such a meaning is made possible by both interpretations (complex construct and sum). The analysis of the one-element reading has been omitted in the summary due to it being non-default in light of the law of simplicity.

The association of form discussed above leads to the problem of building one’s judgment upon the knowledge of the world. Ultimately, the low number of correct answers may be a combination of the effect of the multi-element reading of the figure as well as the application of knowledge coming from the everyday experience. That is not enough, however, to overcome the naturally occurring two-element interpretation of the plane of the figure, which in turn is incompatible with the chosen idea characterizing the construction of the very pictogram.

What is significant is that associating the perceptual experiences with e.g. reasoning with analogy-based interpretation does not always lead to a clearer representation of a perceptual notion, as demonstrated by the *open* pictogram. Because of such a situation a designer should pay attention to the fact that a geometric form representing a given perceptual notion, created based upon building on analogies, could cause perceptual experiences that are inconsistent with the assumed perceptual notion.

The test kit developed during research is heterogeneous in terms of the semantic accuracy of pictograms and reveals interesting properties of perceptual experiences emerging during the design process. It is composed of pictograms accurately depicting perceptual notions both individually as well as in complex constructs.

Therefore, ambiguity of a pictogram cannot be assumed a failure in the choice of a representational form for a perceptual notion. The result of semantic proximity of various notions and their affiliation with the same groups of mutual interactions and ambiguity is that depending on

the factors determining the respondent's choice meanings different than target are assigned to pictogram, but derived from a group of similar conceptual range. That is, e.g. the pictogram *dynamic* can be assigned a meaning from the group including notions concerning movement, asymmetry or chaos, while the pictogram *static* would be assigned those from the groups including calmness or rhythm.

Another valuable indication of the research results is the significant difference in the perceptual experiences of pictograms between architects and non-architects. The full paper will feature a broader analysis of the reasons for that based on the more accurate descriptive tests of the pictograms *concave* and *convex*.

The demonstrated observations reveal a process of designing a research methodology, which is aimed to build a theoretical paradigm that applies analytical psychology to practical aspects of the design process for architectural spaces. The created methodology provides a way to identify and describe known and unknown perceptual experiences emerging during the process of designing architectural spaces.

References

ARNHEIM, R. **Sztuka i percepcja wzrokowa**. Warsaw: Wydawnictwa Artystyczne i Filmowe, 1978. Original title: Art and Visual Perception: A Psychology of the Creative Eye. Free translation/traduçao nossa.

BOHDAN, L. Przedmowa do wydania drugiego. In: JULIUSZ, Ż. **O budowie formy architektonicznej**. Warszawa: Arkady, 1973. Free translation/traduçao nossa.

COVER, T. M.; THOMAS, J. A. **Elements of Information Theory**. Hoboken, New Jersey: Wiley-Interscience, 2006.

DONDIS, D. A. **Primer of Visual Literacy**. Cambridge, MA: The MIT Press, 1973.

JUNG, C. G. **Typy psychologiczne**. Tradução de Robert Reszke. Warsaw: Wydawnictwo Wrota - Wydawnictwo KR, 1997. Original title: Psychologische Typen. Gesammelte Werke. Band VI.

ŻÓRAWSKI, J. **O budowie formy architektonicznej**. Warszawa: Wydawnictwo Arkady, 1973. Free translation/traduçao nossa.