How to Measure the Impact of Spatial Aesthetics on the Everyday in Soviet Housing Estates?

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Abstract. This article describes a new method of measuring the influence of spatial aesthetics on preferability of scenes in the everyday in the Soviet residential areas of Riga – Agenskalna priedes, Kengarags, Zolitude and Lenina (Brivibas) iela. Serving as a rule, this method can also be used for the assessment of likability in urban spaces of other periods. In this case, the measurement table needs to be adapted to another scale. Discoveries in environmental psychology and evolutionary aesthetics inform the method largely. Scientists of this field have suggested that spaces with certain content, prospects and refuges, for instance, are liked and used by humans. Conversely, spaces that do not possess these contents are disliked and avoided. The last decade has also shown some attempts to introduce more specific measurements such as width, heights and length of spaces as well as size and counts of prospects, measured in meters, to describe the preferable spaces more precisely. The aim of this article is to analyse recent findings that propose concrete measurements of likable and dislikable spaces, to assemble them into a so called *model of spatial measurements* as well as to apply the model to the Soviet housing estates in Riga. The model of spatial measurements, which constitutes the basic tool of the method described in this article, can be used only, when open spaces in question have been measured in three dimensions. The model will be applied in four case studies from Riga, that will be introduced in detail in the chapter about the results. The application will allow a simple evaluation of any public space regarding its predicted likability, as long as one can measure its ground width, length, and heights of the buildings surrounding this space as well as count prospects and refuges. The model needs to be tested by consulting qualitative interview material on likability and perception *in situ*.

Keywords: spatial aesthetics, preferability, model of measurements.

Introduction

The question of how spatial aesthetics influence human's everyday life has challenged many. Yet, there is no reproducible method existing that can be used to measure this influence. In the times, when the Soviet housing estates are prone to be reconstructed and their reconstruction is meant to serve as an improvement of livability for the inhabitants, it is crucial to come up with a method that permits predicting preference of an outdoor space. Such method also helps to ascertain people's willingness to use and appropriate an outdoor space in order to model the reconstruction process accordingly. The aim of this article is to propose a new model of spatial measurement, based on evolutionary aesthetics and environmental psychology theories, that is capable to predict which spaces are potentially preferred by inhabitants and which are not. For the purpose of this article, a preferred scene equals a scene that is willingly appropriated, a disliked scene is a scene that is abandoned. The model differs from all other approaches which are currently in use, as it is three-dimensional and reproducible. To reach the aim of the article there are a few objectives in place: the existent measurements that are already calculated by numerous scientists on pleasant and unpleasant spaces, on spaces that induce feelings of safety or feelings of danger, on spaces that contribute to restoration or stress and alike need to be assembled into a united model. Based on layout plans of the areas, the actual three dimensional measurements need to be carried out and, based on visits and photographs, the crucial elements, such as prospect and refuge, need to be counted. After that, the model of spatial measurements can be applied and potentially liked and disliked spaces can be detected.

Importantly, that spatial aesthetics in the context of this publication is defined as human visual perception field *in situ*. In an urban setting, the visual perception field is mostly defined by walls of houses. As opposed to a natural landscape, where, for instance, an ever-lasting field or moving foliage form a very blurred border of a visual field – the parameters of which are hard, if not impossible, to measure; a city possesses spaces that can be expressed in meters. Thus, spatial aesthetics are defined by the positions of walls of the buildings, their width, height, length as well as prospects and refuges these walls build. For the purpose of this article on the Soviet residential areas, the walls (not façades) are of specific significance, since they are the only elements that are expensive in reconstruction. The remains – façades, greenery, roads and everything also heavily influencing the sight – can be constructed or reconstructed if inhabitants voice the necessity. The created model, however, needs to be tested by acquiring qualitative data via interviewing inhabitants of the areas in question, which is the purpose of another article.

Method

The Choice of Theoretical Framework

There are numerous methods already used in landscape and urban settings which attempt to reach a similar aim – namely, to detect the impact of spatial aesthetics on the everyday, or some part of it, and I will introduce them shortly. A method that seems to have established itself in landscape research studies analyses the character of landscape in relation to perception [5; 14; 32; 34]. Such a method is largely based on environmental psychology theories as established by Kaplan's seminal work "Peceptions of Landscape: Conceptions and Misconceptions", too [17]. Back in the day, he created a matrix for evaluating the aesthetical qualities of nature, which are based on variables as mystery, legibility, coherence and complexity. These concepts in contemporary landscape theory turned into a sophisticated matrix of perceptual values: complexity, unity, cosiness and grandness [27; 24]. Regardless of their apparent poetic connotation, these concepts are strictly defined and thereby, allow researchers to use them for the analysis of landscapes. Mystery, for instance, shows how much new information a scene promises, legibility shows how much information is available from a certain vantage point and grandness shows how overwhelming a scene is. These concepts, applied on rural scenes, seem to be very convenient. Yet, an urban environment demands precise measurements of planned space and such concepts, undoubtedly valuable as we will see in the framework of the model presented in this text, cannot stand alone.

A method used in urban studies, namely spatial syntax, claims to analyse the interaction between social and physical realms in the city [10]. However, the fact that this empirical approach is only focussing on pedestrian movement on a two dimensional layout plan, provides hardly any possibility to use it for examining the influence of three-dimensionality on the urban space [3].

Another interesting method used in urban studies employs Geographic Information Systems (GIS). This method also gains popularity as it ascertains urban as well as rural spaces [22]. Yet, this method lacks theoretical input for choosing exact elements of analysis.

There is a large body of urban design literature that focuses on finding the ideal proportions of urban streets and squares or the "human scale". Often, large samples of qualitative data are used to support the findings. In many cases, also environmental psychology terms, such as mystery or legibility, are borrowed to qualify scenes [6]. However, most of the measures are expressed in proportions (1:2) and subjectively given levels (for example medium, high or low level of mystery), which makes this method not reproducible on an objective basis.

As we can see, none of the methods mentioned, employed to investigate the existing urban spaces, can serve to understand the impact of spatial aesthetics on the everyday – space, as constituted by the walls of the buildings, their width, height, length as well as prospects and refuges, in order to ascertain which spaces are potentially preferred by inhabitants. Even though, some environmental psychologists and evolutionary aestheticians are interested in the urban environment and attempt to provide objective points of reference to measure three-dimensional space and predict its likability. These attempts are not yet part of a solid, widely used method, but rather bits and pieces of discoveries, that could become a method once connected. One of the objectives of this article is to compile a model, that can serve as a basis for such a method. I will shortly introduce now few concepts popular in both above mentioned fields.

The Main Concepts of Environmental Psychology and Evolutionary Aesthetics

The main premise of environmental psychology and evolutionary aesthetics is the belief that every human's most important aim is to survive and reproduce. Spaces, faces, smells, sounds etc., that promise the achievement of this aim cause happiness – the ones that predict or promise failure, cause disgust or fear. These emotions, processed through human's consciousness, turn into feelings of preference – like or dislike regarding to a particular space or anything else for that matter.

Appleton's The Experience of Landscape has been ground-breaking for investigating spaces. He established two theories of evolutionary aesthetics about landscapes: habitat theory and prospect-refuge theory [2]. He writes: "... aesthetical satisfaction, experienced in the contemplation of landscape, stems from the spontaneous perception of landscape features, which in their shapes, colours, spatial arrangements and other visual attributes, act as a sign-stimuli indicative of environmental conditions favourable to survival ..." [2, *69*]. Appleton calls the above mentioned finding habitat theory. Appleton also states that humans evaluate any physical surroundings in which they find themselves with regard to the presence of prospect and refuge elements in those surroundings [20; 2, *70*]. He calls an 'unimpeded opportunity' to see – a prospect, and an opportunity to hide – a refuge, hence, it is his prospect-refuge theory [2, *73*].

According to Appleton, the physical shapes of a prospect may be direct or indirect. The first one ranges from a panorama (360° wide view) to a straight single as well as a multiple vista

(narrow view or views). The panorama has no limitations as regarding to sight – vistas, however, are restricted in some directions. Both direct prospects, panorama and vista, are available from the standpoint of a person. Indirect prospects, on the other hand, are secondary panoramas and secondary vistas, which are available only potentially, such as meandering medieval streets.

Appleton was less explicit regarding the description of the physical shape of a refuge. Later, Woodcock refines Appleton's work and defines two types of refuges: primary and secondary refuge [37]. From now on, I will use Woodcocks terminology about refuges. "Primary refuge measures the degree to which the viewer of the scene appears to be hidden from the view of others; secondary refuge is a measure of the number and quality of the other refuges available" [37, *25*]. In other words, secondary refuge, opposed to the primary refuge, is situated at a distance from the observer. Primary refuge, in turn, surrounds the observer.

The next spin to this theory comes in 1979, when Kaplan presents his four categories (open, undefined scenes; spacious, well-structured scenes; enclosed scenes and blocked views) under the name of category-identifying methodologies (CIM). He provides an empirical theory, where three-dimensional environments are grouped according to their spatial shape, information and the action they cause as well as preference [15]. Kaplan was the first researcher to use so called lay-man in establishing CIM, while previous studies were merely based on so-called 'expert categories' [18]. Kaplan created CIM with the natural setting in mind, but they can be used in an urban environment, too, as already has been done [11]. In scenes with a low information level, chances of predicting what Kaplan calls 'potential actions' are limited, and vice-versa [8].

The category open, undefined scene is characterized by large, empty scenes that hardly possess any clues for potential actions – an open field or a large square, for example. Due to a lack of any space-organizing elements in such settings, a person's 'inner meter' cannot measure how small or large it is. According to Kaplan, this category is ranked with low preference. The category spacious, well-structured scene assembles environments that are spacious and provide some landmarks, structuring the given space into 'rooms', where different potential actions can take place. This category is the best-liked one [15]. The category enclosed scenes includes settings that "involve spatially well-defined dimensions with relatively limited depth" [15, *11*]. Kaplan describes them as having the size of a car. The size will be 'adjusted' later in this text. This category is not particularly popular. The last category blocked

views includes environments where visual access is denied, as when in front of a blank, long wall. 'Blocked views' "make it difficult to find a direction in which to proceed" [15, *14*]. This category is the least liked one. In one of the studies which apply Kaplan's categories in an urban setting, Herzog [11], who also interviewed lay-man, discovered a similar correlation between predicted preference ratings and spatial categories. The categories 'open, undefined', 'blocked-views', 'enclosed' were least liked and 'spacious, well-structured' settings were the most preferred ones. The categories themselves already propose a matrix that is in tune with the purpose of this article – to define liked and disliked spaces. However, there are also some downsides of the definitions of categories.

Both, Kaplan's and Herzog's, works use relative terms to define spatial categories: "spatially well-defined dimensions" and "too large". Yet, how large is too large to provide cues for potential action? How enclosed is too enclosed to ban information? How prominent are structures that organize a space into well-structured one? It seems that the only category that can be understood clearly from the literature is blocked view – which describes a situation in the city where people find themselves facing a monotonous wall. Thus, I will not search the measurements of this particular category, but look at the work of some scientists who tried to offer concrete metrics of three other categories. To render the found measurements into a system that can be reproduced for further usage, I will correlate them with the above mentioned categories of space.

The Model of Spatial Measurements

American environmental psychologist Stamps asked hundreds of lay-man to rank images of squares, focussing on the relationship between preference and enclosure [29]. Each of the squares was 49 m x 49 m large, but the heights of the buildings comprised three types: two stories (7.8 m), four stories (13.4 m) and six stories (19.8 m). The total gap size (the space between the buildings) varied from 7 m to 21 m, with different gap locations (middle, corners, both). His research proves that 49 m x 49 m squares are perceived as being safe, if the gap size is 14 m and the buildings are four stories high. Same yards are perceived as too wide if the buildings are two stories high. The difference in perception of safety declines, if the number of stories is larger than six. Stamps includes only one direct prospect in this setting and there is no refuge in it. In addition to that, Galindo and Hidalgo write "… the settings that … allow the individual to observe the scene from a safe viewing point and with a wide perspective (open places) — will also be the aesthetically preferred settings" [7, *24*].

So how do Stamps' findings correlate with three categories, for Stamps does not talk about any of the categories, even though, he is very well acquainted with them? His results demonstrate that the safest, optimally enclosed space is measurable. They also show that humans feel less comfortable if parameters change. According to Kaplan, maximum safety and preference is linked to the category 'spacious, well-structured space'. This is the reason, why yards and squares of the above-mentioned "ideal" dimensions calculated by Stamps will be further considered as a sample for identifying spacious, well-structured spaces in my research.

Yet, it is hard to believe that this sample is the only preferable yard space on earth. A new perspective to this issue is constituted by Spreiregen and Hayward & Franklin, who argued that not the actual size, but the height/depth (HD) ratio plays the decisive role with regard to the perceived enclosure. [28; 9]. Furthermore, contemporary scientists such as Alkhresheh also proved the usefulness of taking HD ratios into account [1].

The current HD ratio of Stamps' ideal square is 0,27. Accordingly, the optimal plaza space (49 m x 49 m, four stories at a height of about 13.4 m) can be increased proportionally in order to maintain the ideal size of a space. So, how far can parameters be stretched proportionally, while still maintaining their optimal spacious, well-structured virtue?

In order to resolve this issue, the analysis of preferred settings done by Herzog et al. is helpful [12]. These researchers have rated different urban and rural scenes according to their likability and assumed restoration effect. Again, in this research, Herzog does not talk about categories, but rather about the most preferred scenes. Thus, scenes which are most liked by non-experts are scenes that Kaplan calls 'spacious, well-structured scenes'; disliked ones are 'enclosed' or 'open, undefined scenes' or 'blocked views' – this represents a similar outcome compared to the conclusion of Stamps' findings. In this case, I took images depicting the smallest of large (larger than 49 m x 49 m) least-liked settings into account. For instance, a square of approximately 75 m x 75 m with few parked cars visible, embraced by six stories high houses and a gap of 24 m, demarcated by an approaching street. The relevant literature does not provide any evidence, neither photographical nor written, that any smaller disliked spaces of this particular ratio exist. Below this margin (75 m x 75 m, 21 m, ratio 0,27), the category 'spacious, well-structured space' begins. This space is an enlargement of 50 % in relation to the ideal space as defined by Stamps.

The variable that differs in both cases of squares described above, are prospects. Stamps' yards had one primary prospect in form of a gap between the buildings, yet Herzog's space possesses a secondary prospect: a street approaching from the left side. Scenes with secondary prospects are more popular than scenes with direct prospects, since secondary prospects, such as bending streets, promise more information [23]. This might mean that a visitor of a yard larger than 75 m x 75 m would find the space likable, since a secondary refuge would encourage stronger feelings of preference. I will explain the significance of elements such as prospects and refuges subsequently.

Note, that both aforementioned spaces (plaza of 49 m x 49 m, surrounded by buildings 13,4 m of height and a yard of 75 m x 75 m, embraced by houses of 21 m of height) have ratios of 0,27. I will now introduce the ratio mark that indicates the change of a category, in order to correlate the measurements and categories according to the principle of analogy. Based on Stamp's ideal square (plaza of 49 m x 49 m, surrounded by buildings 13,4 m of height), I have chosen a ratio fluctuation of 0,5 points, as it reflects the difference of approximately two stories. Stamps indicates that two stories are enough to feel changes in safety and there are no other points of reference in the literature that indicate the perceived changes in ratio [29]. Thus, if the ratio is at least 0,5 points lower than the ideal ratio of 0,27 - namely, lower or equal to 0,22, then the space has to be called 'open and undefined'. The other side of the scale, a ratio which is 0,5 points higher than 0,27, marks another category called 'enclosed spaces'. So, if the ratio is higher or equal to 0,32, then the space is called an 'enclosed space'.

Now, after having established a ratio for all three categories, I will determine the missing smallest likable width and length parameters for the category 'spacious, well-structured'. In order to be precise, I will use a height of 13,4 m, like I did before. The ratio of 0,32 points at a height of 13,4 m is achieved, if the length and width of the square is 42 m. Thus, one can say that humans are not comfortable in the existing environment, if the ground space is smaller than 42 m x 42 m. Hence, this is the limit at the lower end of a 'spacious-well structured space'.

Based on the metrics and ratio fluctuations detected above, I will now derive the missing width and length parameters of an 'enclosed' and 'open, undefined yard space'. The smallest width and length parameters of an 'enclosed space' are 1 m each, the largest ones correlate with the upper border of 'spacious, well-structured space' – 75 m. The smallest 'open, undefined space' length and width parameters correlate with the smallest 'spacious, well-structured space' measurements – 42 m, the largest are 100 m.

In short, yards that are 42 m – 75 m large and surrounded by buildings that are 13,4 m – 21 m high, within a height to width ratio, that is larger than 0,22 and smaller than 0,32, compose a setting that is defined as likable within this framework. Thus, it corresponds with the description of a 'spacious, well-structured environment'. Spaces with smaller or larger parameters and spaces with smaller or larger ratios are either 'enclosed' or 'open, undefined settings'. Spaces that possess at least one primary prospect like in Stamps's examples and fit into the measurements and ratios given above, are called 'Standard yard spaces'. 'Spacious well-structured yard spaces' within the above mentioned parameters are liked and, within the framework of this article it is assumed, that the liked spaces are the ones that are used and appropriated in the everyday. Accordingly, the yards fitting the parameters of disliked spaces are assumed not to be used and appropriated.

There are some peculiarities that are equally important as length, width, height and ratio. Namely, specific prospects and refuges called legibility and mystery. As it has been indicated, I will describe them more precisely in the following, after explaining the measurement system for streets.

Research done by Alkhresheh contributes to the issue of safety and comfort by investigating cognitive variables, such as the feeling of enclosure with regard to streets [1]. Alkhresheh generated images and conducted a survey on very long, seemingly endless and straight streetscapes with setbacks of façades indicating a crossroad in the middle and background parts. The straight view complies with the direct type of vista, but the setbacks comply with the idea of secondary refuge as identified by Woodcock: a scene with a potential hiding place in the distance [37]. I will use one primary prospect and one secondary refuge for all street space categories in order to define 'standard street spaces'.

In his doctoral dissertation, Alkhresheh not only describes the ideal ratio(s), but also gives measurements of preferred streetscapes [1]. His extensive empirical research, which was conducted as a streetscape ranking survey (comfort, safety, perceived enclosure), has shown that the most optimal streetscapes are those that comprise a height to width ratio value of 3:4. The function of comfort and safety shows an inverted U-shape. With regard to Stamps, Alkhresheh also does not talk in terms of 'spacious, well-structured streets' and does not use any of the other three categories for that matter. Yet again, the most comfortable, safe streetscape should be ranked as 'spacious, well-structured', since that description fully corresponds to the concept of a 'spacious, well-structured space'. Conversely, streets that are too enclosed belong to the category 'enclosed space' as well as streets that are too large and wide, these ones belong to the category 'open, undefined space'.

According to Alkhresheh, streetscapes that make humans feel comfortable and safe, reveal ratios of 0,5 to 1.5, with 0,75 being the ideal ratio [1]. Alkhresheh's findings are valuable for my work, since they provide ratios for streetscapes that I will use. His presented concept of an ideal street includes a height and width range of 6 m to 12 m. This research shows that values between 6 m to 12 m, within the given ratio, define a 'spacious, well-structured street'. Ratio and height/width measurements that exceed the given ones, tend to be far less popular. The ideal streetscape is 9 m high and 12 m wide with a ratio of 0,75. The optimal street view proposed by Alkhresheh clearly fits into the requirements that Kaplan proposes for the category 'spacious, well-structured scenes' [15].

Lindal and Hartig demonstrate similar findings, too [21]. Higher buildings or a shorter distance from the street turn a similar space into an enclosed setting. They found, that the safest street is 14 m wide and is surrounded by houses that are 11 m high. Buildings higher than that create feelings of extreme enclosure and thus, generate negative feelings of being entrapped. I will use the measurements by Lindal and Hartig as a basis for my research, since they are closer to the real situation in Riga.

So far, it is known that the ideal streetscape is 11 m high and 14 m wide, this ratio can fluctuate between 0,5 to 1.5, 0,75 being the ideal ratio. Such a street has one primary prospect and at least one secondary refuge. The ratios are relative, as we have seen in the example with yard spaces. For instance, a street space that is 75 m high and 100 m wide, is hardly pleasant, even though the ratio is 0,75. Again, I have to ask a similar question compared to the one in the part about yards: Where is the turning point (expressed in meters) that marks the beginning of streetscapes being too large or small and disliked? I will use the same enlargement procedure that I used for yards, too. In case of the yards, described above, the 'ideal' size has been increased by 50 % to detect the upper boarder of a 'spacious, well-structured street'. I will use Lindal and Hartig's standard (11 high, 14 wide street) and enlarge it by 50 % [21]. The result is the largest possible 'spacious, well-structured street' being 16,5 m high and 21 m wide. A street exceeding these limits is either an 'open, undefined street' or an 'enclosed street', depending on ratio. Alkhresheh himself ranks spaces larger than this as not particularly safe or comfortable, too [1]. Thus, this is the first divide between two categories of streetscapes. I will leave the smallest end of a 'spacious, well-structured street' at the point of

TABLE 1

Standard spaces [Source: created by author]

Category Setting	Length as bordered by walls (m)	Width as bordered by walls (m)	Heights of buildings (m)	Ratio	Prospect amount/ type	Refuge amount/ type	Mystery	Legibility	Preference
Spacious-well structured yard	42−75	42−75	13,4−21	0,27 + - 0,5	1 primary	−	−	−	Liked
Open-undefined yard	> 42−100	> 42−100	> 8,5−21	< 0,22	1 primary	−	−	−	Disliked
Enclosed yard	1−75	1−75	> 14−26	> 0,32	1 primary	−	−	−	Disliked
Spacious-well structured street	Unl.	11−16,5	14−21	0,5−1,5 Ideally 0,78	1 primary	1 secondary	−	−	Liked
Open-undefined street	Unl.	11−43	14−21	< 0,5	1 primary	1 secondary	−	−	Disliked
Enclosed street	Unl.	1−16,5	14−25	>1,5	1 primary	1 secondary	−	−	Disliked

11 m in height and 14 m in width, since in Riga's residential areas there are no buildings smaller than that and of interest for me anyway.

From the 'ideal' street space given above, I will now detect the smallest and largest parameters for two other categories analogically, as I did for the yard spaces. I will start with 'open, undefined street spaces' and will continue with 'enclosed streets'. Yet, I will use different ratios – these ones already established by the findings of Alkhresheh. The starting point is 0,75 – the ideal ratio. When 0,25 are subtracted, resulting in the smallest ratio of 0,5, the ratio for the category 'open, undefined street' is achieved. If 0,75 is added, then the largest ratio is reached – 1,5. Similar to the yard spaces, the largest ratio corresponds to an 'enclosed space' and the smallest to an 'open, undefined environment'. The smallest width parameter of an 'open, undefined street', in analogy to the instance of yard spaces, correlates with the smallest width parameter of a 'spacious-well structured street' and it is 11 m wide. Further, derived from a maximum height of 21 m – the highest 'spacious, well structured street' building, which is also the highest

possible height of a building in an 'open, undefined street' environment - one is able to detect the largest width parameter of an 'open, undefined street space'. It must be two times the height in order to receive the ratio 0,5, hence, it is 42m. Thus, 42 m is the widest street parameter in the category 'open, undefined street'. The smallest enclosed street width is 1 m. The largest width parameter is 16,5 m, which corresponds to the largest width parameter of a 'spacious, well-structured street space'. This correlation is similar to the principle used in case of yard spaces. Accordingly, the highest building of an 'enclosed street space' is 25 m high – which is derived from the given width (16,5 m) multiplied with the ratio 1,5.

In short, streets that are 11–16,5 m wide, surrounded by buildings that are 14–21 m high, within a height to width ratio of 0,5–1,5, compose a street that, in this framework, is defined as a preferred one. Thus, this type of street corresponds to the description of a 'spacious, well-structured environment'. Spaces with smaller or larger parameters and spaces with lower or higher ratios, are either 'enclosed' or 'open, undefined

streets'. Spaces that possess one primary prospect as well as one secondary refuge and fit into the measurements and ratios given above are called 'standard street spaces'. Spacious, well-structured streets are considered to be liked and appropriated in the everyday. Conversely, the streets that fit into the parameters of disliked spaces are assumed not to be used and appropriated.

The specifics of length, width, height, ratios as well as prospect and refuge of three different categories explained above, namely, the category 'spacious, well-structured, open, undefined and enclosed space' is summarized in Table 1 below. As I already mentioned above, the fourth category, 'blocked views', is well described in the literature and does not need to be measured.

Table 1 only provides measurements for rectangular spaces – but how to treat irregular yards? In order to attribute a theoretical category and to find a ratio of the space according to the literature, one needs to divide height by width or length. Unfortunately, there is no answer to the question, as to the procedure applied in the case of irregular spaces. However, I am convinced that it is reasonable to analyse slightly irregular yards by calculating the medium size of the side, which is one fourth of the sum of all four sides. For example, if the sides are 60 m, 80 m, 90 m and 110 m long, then the medium length is 85 m. However, this calculation only makes sense, if the difference between the sides is not too vast and also, if the yard actually has four sides. If the difference between the sides is two times the smallest side, then the size of the smallest side is taken as a reference length for the whole area. This means, if the sides of a yard are each 30 m, 100 m, 30 m and 100 m long, the medium length is 30 m (and not 65 m). Such a yard is more like a street space. In case of a street, the length of the view is not significant - at least this is how street spaces are treated within the scope of this work. When calculating the ratio of a yard, it makes sense to treat street-like yards the same way as streets, i.e. to take only the smallest side (width and not the length of a street) and height of the buildings into consideration. In the case of triangles, which only occur rarely, the measurements are calculated by extracting one third of the sum of three sides.

In the case of buildings with variant heights within the visual field of one scene, the same principle applies. If the difference between the heights of the buildings is not too large, then a medium height is calculated by adding together the different measures of height and dividing them by the number of the heights added. If the scene is defined by the buildings, the height of which is considerably different (the smallest height is two times smaller than the second smallest height), then the height of the largest building is taken as a parameter.

If a scene is constituted by 'blurred' arrangement of buildings, such as houses placed in fishbone or zig-zag patterns, then the closest corners of the buildings must imaginatively be linked together. The link has to be considered as the border of the given setting.

Adding the Elements of Mystery and Legibility to the Model

Having constructed the metric standards to identify three spatial categories, I realized that the above mentioned prospects and refuges can vary a lot in any given case. This means, that an application of such standards to spaces in Riga's residential areas turns out to be problematic. For instance, think of a square or a yard that does possess the 'ideal' size, shape and height. Namely, a yard that is 49 m wide and long and surrounded by walls that are 14 m high. However, this yard has three secondary prospects and two secondary refuges instead of one direct vista. Is it more popular and appropriated, rather than the 'ideal' square which has only one direct prospect? Is it possible that a decent amount of secondary refuges is able to alleviate the dislike of a space that, according to the standard, would fit into an 'open, undefined setting'? Does a balanced feeling – something between like and dislike – appear in such cases? If yes, I will preventively call this feeling 'toleration' and accordingly, call the corresponding spaces 'tolerated spaces'. A tolerated space is, in terms of like and dislike, in the middle of the scale. Hypothetically, under certain circumstances tolerated space can become a space that is appropriated by inhabitants, especially if there are no spaces in the proximity that are more popular.

To investigate how and which kinds of prospects and refuges influence the attachment to certain spaces, two more supplementary concepts, already mentioned in this article, need to be included in the aesthetical assessment framework: legibility and mystery. The former is a specification of a prospect, the latter is a particular type of refuge. According to Kaplan, the prospect as a promise for more information accessible at the current moment develops into the concept of mystery. The secondary refuge as a possibility of making sense of a scene from a safe vantage point contributes to the concept of legibility [17]. I include these concepts, but no other elements such as complexity, coherence etc. (see above) in the assessment model, as empirical investigations prove that high levels of mystery and legibility correlate with higher preferability [23].

Note, that not every secondary refuge represents legibility and furthermore, that not every secondary prospect promotes mystery. Legibility is provided by

TABLE 2

Allowed Deviances [Source: created by author]

Category Setting	Length as bordered by walls (m)*	Width as bordered by walls (m)*	Heights of buildings (m)*	Ratio	Prospect amount/ type	Refuge amount/ type	Mystery	Legibility	Preference
Open-undefined yard	> 42 − 100	> 42− 100	> 8,5−21	< 0,21	Not relevant	Not relevant	At least 1	At least 1	Tolerated
Enclosed yard	1−75	1−75	> 14−26	> 0,33	Not relevant	Not relevant	At least 1	At least 1	Tolerated
Open-undefined street	Unl.	11−43	14−21	< 0,5	Not relevant	Not relevant	At least 1	At least 1	Tolerated
Enclosed street	Unl.	1−16,5	14−25	> 1,5	Not relevant	Not relevant	At least 1	At least 1	Tolerated

* If parameters are two to three times larger than parameters of the upper border, then there should be two to three times more mystery/legibility in order to rank the space as tolerated.

a secondary refuge, creating the possibility to understand the scene from a safe vantage point. If, from this refuge, one would look onto another part of a scene that is not completely available from the initial standpoint, then the observer would see yet another portion of the given setting. Not every secondary refuge offers more information of a scene as the original standpoint does. Regarding the mystery component or the secondary prospect, "the preference for scenes where it appears as if one could see more if one were to 'walk into' the scene a ways" [17]. The possibility of gaining more information is provided by a prospect that is a 'bended, curved' or 'fractured vista'. Only straight vistas do not represent mystery.

There is no literature on how to combine metrics and mystery as well as legibility elements in the evaluation of spaces. We only know that their presence positively influence preference. The 'standard open, undefined, disliked space', according to my framework, becomes 'tolerated space', if there is at least one element of mystery and one element of legibility. If the setting is twice as large as a 'standard open, undefined space', then two elements of mystery and legibility are needed in order to outbalance dislike and turn the space into

tolerable one. The same applies for 'enclosed spaces'. The 'standard enclosed, disliked space' turns into a tolerated one, if there is each, one element of mystery and one element of legibility. If the size of a standard space is doubled, mystery and legibility need to be twice as high as the original amount and so forth. I will call such deviances from standard metrics of categories 'allowed deviance', which will serve as a predictor of tolerated settings.

Mystery and legibility will be only measured within a distance of 75 m. Namely, the upper border of 'spacious, well structured space' in my framework. Logically, there is no use of a single secondary refuge within a distance of 200 m. Such a distance is too far to be reached within a 'safe' time frame. The explanation given above is summarized in Table 2.

Field Work Methods

Methodologically, my work presents an innovation, as not only the spatial measurement model constructed above was never used before, but also because my work was conducted in situ. Most research on spatial categories or on related topics relies on photo and video material, drawings

or computer simulated images of spaces as stimuli for participants to rank spaces according to preferability and/or feeling of safety, comfort, enclosure etc. [33; 13; 30; 21; 35]. I will, on the contrary, use formal standards and deviances in order to predict the category in real space. In the following part, I will explain the method used to collect data in this field.

I have selected 80 possible everyday routes in every housing estate, five of which were selected by the random choice principle to avoid subjectivity. Every route runs between two points: the exit of a dwelling to the nearest facility, such as public transport stops, shops, libraries, post offices, parking lots, schools, kindergartens etc. Each route comprises a distance of at least 500 m. Besides, none of the routes is longer than 800 m – a distance, where "psycho-social purposes of neighbourhood [are] ... strongest" [19, *2107*].

Furthermore, on each route five scenes are marked, except for Lenina iela residential area, where the routes are significantly shorter than anywhere else. However, the choice of scenes on the routes is not random. Each time, the visual field changes, it reflects a change in the landscape and a new scene with different visual characteristics has developed.

After detecting the scenes, they are captured by using a photo camera according to a shooting script. A shooting script is a set of guidelines that is closely linked to the research question [31]. The camera is situated at the height of the average eye-level (160 cm) and at the degrees of 180 horizontally and 90 vertically, always facing the walking distance. Although the field of the human vision as well as the informational load of the particular scene depend on age the usage of peripheral vision or movement of head permits humans to mostly perceive the front hemisphere of what is surrounding them and thus, acquire at least a vague idea of the scenery at the angle of 180° [36; 4]. Hence, 180° images represent the field of both – direct and peripheral sights. All in all, I detected 99 scenes for further analysis. This method of camera usage for fieldwork is called photo-documentation [26]. This method forces the researcher to work according to a certain system or a route, instead of pushing the button of a photo camera whenever there is an interesting scene for the analysis [31; 25].

Eventually, the photos and Google earth data of the particular scenes will be measured and analysed. The height to width ratios are measured by using supplementary data from original layout-plans of the residential areas. The determinant points are walls and streets. Attribution of theoretical spatial category is carried out on the basis of measurements and scene elements. Importantly, the notes on irregularities and particular features, such as hills

and groups of trees, have to be marked. In the end, the presence of these elements might play an important role when data, extracted from the metric method, is compared to a set of data from an interview.

Later on, the estimated theoretical preferability ratings will be attached to each scene. Every scene is allocated a number of points: 30–21 means liked; 20–11 tolerated, and 10–0 disliked. The precise number of points depends on the quality and visibility of the mystery and legibility component in the scene. All information about each scene will be displayed in a table.

Lastly, all the scenes in the four residential areas are depicted on a route map. Theoretical categories and likability rankings, as well as borders of each setting, are graphically depicted.

Results and Discussion

The creation of replicable method for evaluation of influence of spatial aesthetics on the everyday and particularly the assemblage of the model of spatial measurements proved to be a complicated process. It was decided that four spatial categories, introduced by S. Kaplan in 1979, will serve as the basic division of all possible spaces in an urban environment. After that, the measurements stated in the last decade by various scientists of liked and disliked, safe and dangerous, too enclosed or too open spaces etc. were fitted to three (one did not need any measurements) of categories, which were also granted different likability options. Categories had to be expressed as spaces of a rectangularish or triangularish shape to adapt them to the measurements. It turned out, that quite a few parameters of liked and disliked, comfortable and uncomfortable, safe and unsafe etc. spaces were already published in the literature. Yet, there were many others that had to be calculated based on an analogy principle, which might be considered to be a downside of the model. To achieve a more differentiated model, the counts of mystery and legibility elements were included. The completed model proved to be easily applicable in most of the cases. The precision of the measurement of spaces in three dimensions played an important role in the process. Yet, there were also a few uncertainties about the application of the model, caused by irregularities of spaces, for instance, if an outdoor space is not a rectangle or triangle, but has a very asymmetric shape. Here, the space's measurement can hardly be precise - this results to be a downside of such a model, too.

In short, 99 scenes were analysed by the metric method, these are:

- 41 open, undefined disliked scenes;
- 28 open, undefined tolerated scenes;
- 19 enclosed disliked scenes;

- 10 enclosed tolerated scenes;
- 1 spacious, well-structured liked scene.
- there are no blocked views amongst the scenes.

It is expected, that the 60 disliked scenes are rejected by the inhabitants, all 29 tolerated scenes are appropriated under certain circumstances, and the only liked scene is appropriated. Depending on amount of prospects and refuges, some of the disliked scenes were rated with the minimum of the possible points – 1, some were rated with the maximum – 10. Yet, some tolerated scenes were ranked with the least possible number of points – 11, which shows that they were ranked closely to the disliked scenes. Some other scenes with 20 points almost reached a liked scene status. The system of points will gain its importance, once the results are correlated with qualitative interviews. For the purpose of shortness, I will not discuss the given points here.

If one looks closer at the distribution of scenes among particular residential areas, then the composition is (in chronological order):

- Agenskalna priedes (24 scenes): 13 open, undefined disliked; six open, undefined tolerated; three enclosed, disliked; two enclosed tolerated scenes;
- Kengarags (36 scenes): 14 open, undefined disliked; ten open, undefined tolerated; nine enclosed, disliked; two enclosed tolerated; one spacious, well-structured liked scene;
- Zolitude (31 scene): twelve open, undefined disliked; nine open, undefined tolerated; seven enclosed, disliked; three enclosed tolerated scenes;
- Lenina iela (8 scenes): two open, undefined disliked; three open, undefined tolerated; three enclosed, tolerated scenes.

The below given visual data summary represents bird's eye view images picturing every route represented by lines and arrows of different colours. Next to the arrow, there is a white circle that shows a letter and a number. The letter indicates the name of the area (A for Agenskalna priedes, K–Kengarags, Z–Zolitude, L–Lenina iela), the first number is the number of the route, the second number is the number of the scene. Every scene is demarcated by a rectangle or triangle. They all represent wall to wall spaces, which can be viewed from a given standpoint marked as an arrow. The colours reflect the following meanings: dark blue represents an 'open, undefined, disliked scene'; light blue represents an 'open, undefined, tolerated scene'; dark green represents an 'enclosed, disliked scene'; light green represents an 'enclosed, tolerated scene' and yellow represents a 'spacious, well-structured scene'.

A route (marked in red) in Agenskalna priedes is composed of five scenes: four yards, one street. Figure 1 represents these five scenes filled with three different colours, representing a theoretical ranking of each scene. The route starts with scene A11 which is ranked as an 'open, undefined and disliked scene'. Then the route proceeds through settings A12 and A13, categorized as 'enclosed and disliked scenes'. In the end, the route leads through the spaces A14 and A15 which are 'open, undefined and tolerated areas'.

As explained earlier in this article, the shape of the yards is defined by the walls or streets. Note, that the shape of settings A12 and A13 is defined by the buildings standing in the front part of the scene. The points, where buildings end, the straight lines of the scenes are seemingly formed by empty air and not by walls or streets. Yet, standing at the viewpoints A12 and A13, the field of vision is strongly influenced by these bordering houses close to the viewer. Hence, the whole shape of the setting is defined by those houses, even though they only border a very small fraction of the space.

Figure 2 shows a route (marked in red) in Kengarags, that includes eight settings. Note, that one of them falls under two types of spaces: street and yard. Thus, there are eight yard spaces and one street space. The route starts with an 'open, undefined, disliked street scene' (K11). Then it moves through a small gap (10 m) between the buildings, which are categorized as an 'enclosed, disliked yard scene' (K12). This kind of gap appears triply on this route, since the groups of houses, through which the route is proceeding, are identical. The following space is an 'open, undefined, disliked yard' (K13).

The route proceeds with two 'enclosed, disliked yard spaces' (K14, K15, the above mentioned gaps), and continues with the yard K16, the form of which is identical to K13, and both are 'open, undefined, disliked yards'. It is followed by an 'enclosed, disliked yard scene', which is just another gap like the one in scene K17. At the end, the first route leads into a scene that splits into two separate settings - an 'open, undefined, disliked street' and an 'open, undefined tolerated yard' (K18.1, K18.2). Note, that this route is mostly passing through disliked settings.

Figure 3 shows a route (marked in red) in Mikrorayon, nr. 2 in Zolitude, that is composed of four street spaces and three yard settings. The first and second viewpoints are 'open, undefined, disliked street spaces' (Z11, Z12). 'Open, undefined, disliked settings' are changed by an 'enclosed, disliked space' that is formed by a yard (Z13). Further along, the red route crosses an 'open, undefined, tolerated street' (Z14) and a horseshoe-shaped yard, which is also an 'open, undefined, tolerated space' (Z15). After that, the route leads through an 'enclosed, disliked tunnel-like space' (Z16) and passes on to an 'open, undefined, disliked street' (Z17).
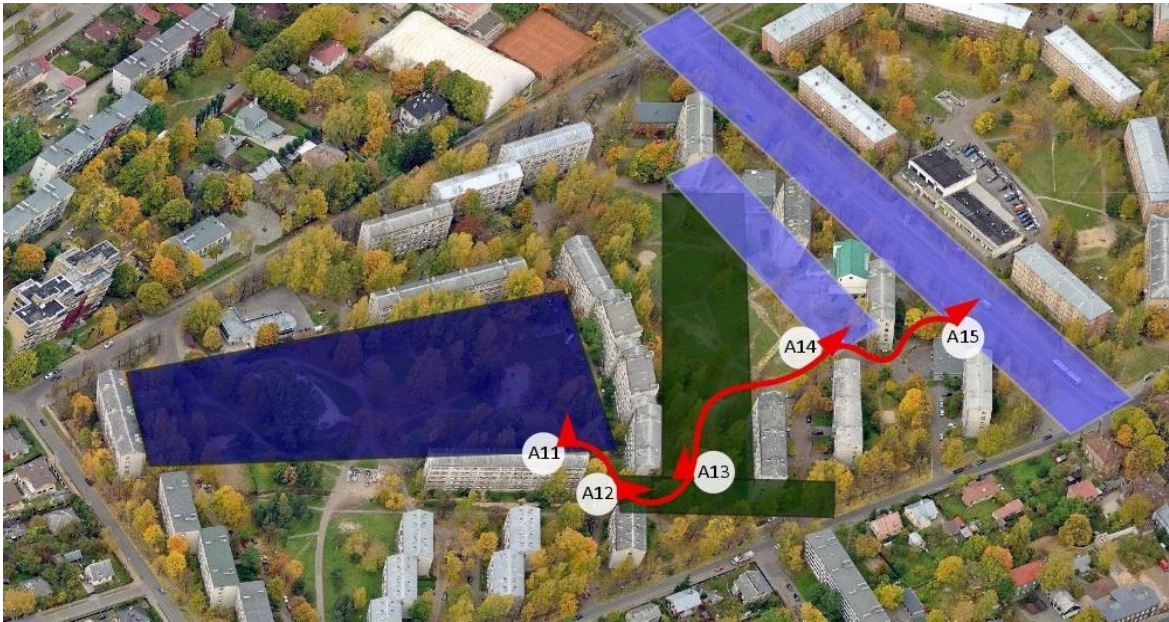
Fig. 1. Agenskalna priedes, first (red) route with five stations A11 – A15. Dark blue – open, undefined, disliked scene; light blue - open, undefined, tolerated scene; dark green – enclosed, disliked scene [Source: created by author]
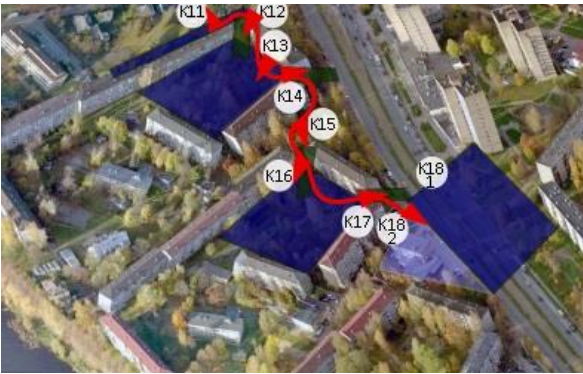

Fig. 2. Kengarags, first (red) route with eight stations K11–A18. 2. Dark blue – open, undefined, disliked scene; light blue – open, undefined, tolerated scene; dark green - enclosed, disliked scene [Source: created by author]
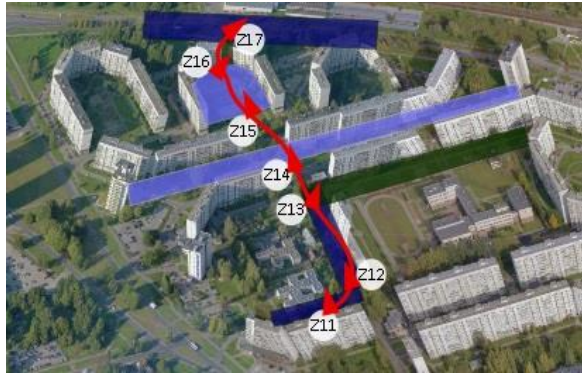

Fig. 3. Zolitude, first (red) route with seven stations Z11–Z17. Dark blue – open, undefined, disliked scene; light blue – open, undefined, tolerated scene; dark green – enclosed, disliked scene [Source: created by author]
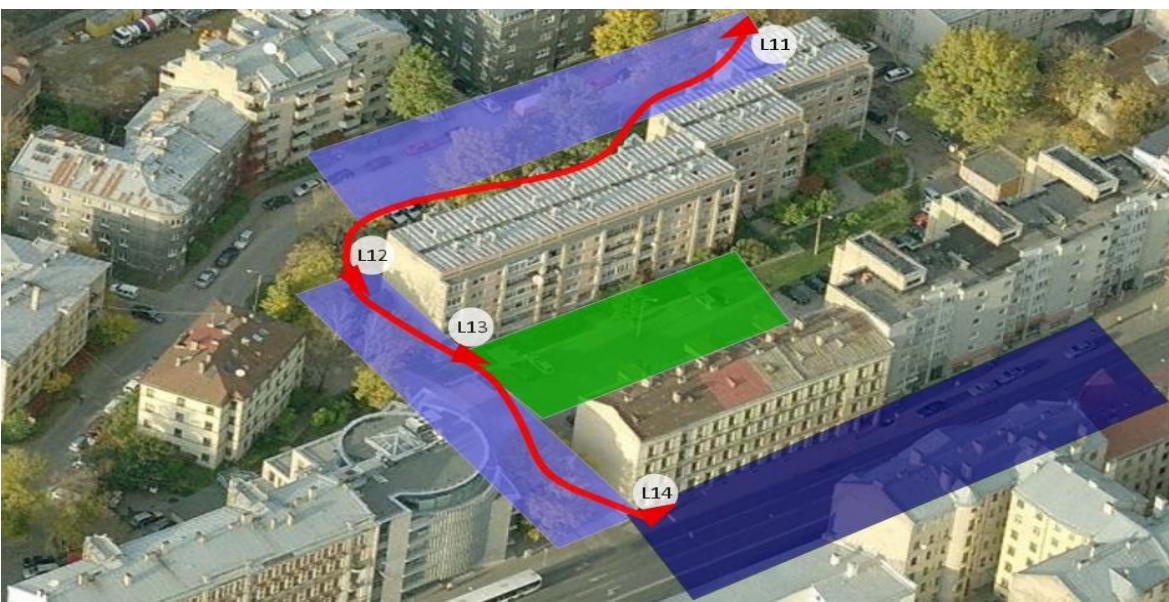

Fig. 4. Lenina iela, first (red) route with four stations L11–L14. Dark blue – open, undefined, disliked scene; light blue – open, undefined, tolerated scene; light green – enclosed, tolerated space [Source: created by author]

The first route shows some quite interesting features of Zolitude – namely, large spaces that would, for their size alone, usually be ranked as disliked spaces. However, they are 'upgraded' to tolerated spaces, because of a reasonable amount of mystery and legibility, which is created by bending house façades and addendums of the buildings on the ground floor level, especially on the street.

Lenina iela (now Brivibas iela) 177 consists of only two blocks of five stories each. Figure 4 shows a route (marked in red) in this area. It contains one yard scene and three street scenes. The first two settings are 'open, undefined, tolerated street spaces' (L11, L12). Here, the size of the housing blocks almost allow these streets to be categorized as 'spacious, well-structured'. The red route also includes an 'enclosed, tolerated yard', which, due to many setbacks, represents large amounts of legibility. At its last point, the route enters an 'open, undefined, and theoretically disliked, street scene' (L14). Interestingly, the last scene is on Lenina iela, which consists of a large number of pre-war buildings.

Conclusion

The aim of this article was to create a model of spatial measurements, based on recent findings in environmental psychology and evolutionary aesthetics, as well as to show its applicability to assess the predicted likability of the Soviet residential areas in Riga. Furthermore, my intention was to develop a model that can also be reproduced in order to measure other modern urban spaces. The above mentioned goals have been achieved. Yet, the model might need some improvements. As an example, the model is created for measurements of outdoor spaces being rather regular than irregular in shape. Assessing yards and streets with an irregular shape is rather difficult by using this model. In addition to that, the issue of HD ratios used in the model needs to be addressed, too. Here, the fluctuation of ratios defining categories is based on observations by Stamps and Alkhresheh. Deeper and wider knowledge of how ratios change among different categories would define the model more precisely. Likewise, the introduction of tolerated spaces presented in this article, meant as a compromise between traditionally known liked and disliked spaces, potentially needs reconsideration – there might be even more than three levels of certain feelings about spaces. In addition to that, it is questionable, if the viewpoint of the observer might change the preference ranking of a yard or a street, since the visual field and thus, the visible space under question, might alternate as one moves further along. Also the fact that mystery and legibility are measured only within a distance of 75 m can be interpreted as a problem. It must be proved if mystery and legibility elements that are situated further than this distance play a significant role, too. All in all, the overall results achieved by this method have to be tested and improved by using qualitative interviews. Most likely, interviews with inhabitants will show that they render the scenes somewhat differently with regard to their preferability and appropriation as well as their visual perception. Yet, the prospects are that social, economic, cultural aspects of each individual will still leave some detectible common pattern of impact of spatial aesthetics in perceiving spaces of the Soviet residential areas in Riga.

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