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Impact of danger, legibility and mystery on visitor's preference in fortified landscapes compared with park landscapes in urban areas

Abstract

Both the parks and historical fortifications constitute important components of urban green spaces in many cities around the world. The approach taken in terms of shaping these spaces often appears similar regardless of provenance. For this reason, recognising the preferences of their visitors is relevant from the perspective of creating and managing spaces that are not only safe, but also interesting. In this study we were interested in how fortress landscapes are perceived compared with typical urban parks in Poland. To this end, we conducted a questionnaire involving 117 participants who evaluated a set of 116 eye-level photographs (58 fortified landscapes and 58 urban parks environments). We analysed a range of correlations and mediation models, testing hypotheses regarding the mediating role of mystery, legibility and danger on preferences towards the two types of studied landscapes. We wished to establish what hidden mechanisms underpin the studied variables as well as their influence on the shaping of the researched landscapes. The results indicate that in the case of fortified landscape, it is important to maintain greenery favoured by the respondents, conducive to diversity and mystery while limiting perceived danger. Legibility can support educational values in the protection and maintenance of fortifications when sites are not devoid of mystery. In the case of park landscapes, legibility should not be improved at the expense of a complete loss of mystery, but should be accompanied by a reduction in perceived danger. In turn, mystery in parks plays an important role because without it, even legible park landscapes cease to be liked by the respondents. In turn, in fortress landscapes, mystery has a strong impact on preference, regardless of its relation to danger and legibility. At the same time, were it not for the fact that legibility reduces sense of danger, legible fortress landscapes would not be liked. Therefore, our findings can support the successful restoration and maintenance of fortress landscapes especially when their function shifts and they need to be managed and maintained in a planned manner in modern green areas.

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1 Introduction

Urban inhabitants need a variety of green areas with a range of values conductive to their well-being (Gunnarsson and Hedblom, 2023). Numerous studies have examined people's preferences to various green spaces in many aspects (Jorgensen et al., 2007; Fischer et al., 2018; Ugolini et al., 2022; van den Berg et al., 2015). They generally looked at perception and preferences in the aspect of vegetation (Yang et al., 2013; Kurz and Baudains, 2012), vegetation complexity (Harris et al., 2018), vegetation density with various development intensity of the park (Schroeder, 1987) or diversity of vegetation (Qiu et al., 2021; Fuller et al., 2007). Aspects connected with perceived danger (Lis et al., 2019a; Lis et al., 2019c) or perceptions of different urban areas such as derelict land and parks by landscape planners and residents were studied (Hofmann et al., 2012).

Studies on preferences for fortified landscapes are few and far between (Pałubska and Melaniuk, 2014; Pardela et al., 2022a; Pardela et al., 2022b). Particularly noticeable is the lack of in-depth comparative research between different types of green areas, which may prove relevant when, for example, historical areas are to be designated for a modern role (e.g. park) within the systems of urban green areas. In this way, not only natural values can be promoted, but also numerous cultural ecosystem services, e.g.: aesthetic values, cultural diversity, educational values, inspiration, spiritual and religious values, sense of place, and recreation and ecotourism (Hølleland et al., 2017).

In this research, we compared two different cultural landscapes: fortresses and parks. We also wanted to determine how fortifications are perceived in comparison to popular green areas in cities – parks. Unlike fortified landscapes, the impact of variables affecting visitor preferences for parks has been well established in the field of environmental psychology (Fischer et al., 2018; Lis et al., 2019a; Hoyle et al., 2017; Lis et al., 2019b; Lis et al., 2022). Various features affecting preferences for landscapes have been studied. One of the most popular perspectives is the Kaplan Preference Matrix. The Kaplans (1987) distinguished four 'informational variables': legibility, coherence, complexity and mystery, which can safely be applied to predict preferences for various types of environment. The first two, which incorporate coherence and complexity, are linked with a two-dimensional view. However, the next two, legibility and mystery, are associated with a three-dimensional view. In our study, we decided to check how the preferences based on these four components develop in relation to fortress landscapes compared with park landscapes.

An additional aspect that differentiates our study is that we decided to include the perceived danger in this research in the group of tested models (3 and 4). Numerous studies have shown that sense of danger has a strong impact on how people feel about green areas (Lis et al., 2019a; Lis et al., 2019c; Fisher and Nasar, 1992; Nassauer et al., 2021). However, relatively few studies have tested danger in the relationship between defined landscape features and preference – e.g. through mediation analysis (e.g. Lis and Iwankowski, 2021a; Lis and Iwankowski, 2021b). We examined the mediating effect of perceived danger in the relationship between legibility, mystery and preference. Our research is relevant because it can help determine not only the characteristics of vegetation in urban parks or other urban green areas that are liked, but also why this is so. This, in turn, can facilitate an understanding of the mechanisms behind how people feel and, as a result, give better predictions. Therefore, we decided to extend the research to analyse the mediating effects in the relationships between the features of both compared types of landscapes and preferences for them.

2 Materials and methods

2.1 Conceptual background

The first variable we investigated was 'coherence' defined as 'a sense that things in the environment hang together' (Kaplan and Kaplan, 1989). This variable is related to the ordering and organising of its elements, defines 'a sense of order', 'directs attention' (Kuper, 2017) and also indicates uniformity and organisation (Shayestefar et al., 2022). This variable also means 'immediate understanding' (Stamps,

2004) which, can be helpful in reading fortress landscape forms (ICOMOS, 2021).

The second examined variable, which is 'complexity', refers to the extent of different visual components in a scene, its richness and intricacy (Kaplan and Kaplan, 1989). According to Kaplan's (1989) theory, 'more diversity in the environment encourages individuals to explore more of the environment'. This variable is also related to 'immediate exploration' (Stamps, 2004). It also specifies the variety of elements, number of colours and organisation (Shayestefar et al., 2022). The positive impact of both two-dimensional factors on landscape preferences has been confirmed by numerous studies (e.g. Herzog and Bryce, 2007), although there are also studies that have yielded different results. For example, research by Kuper (Kuper, 2017) for designed digital landscape models indicate that 'preference increases along with estimations of complexity, but not with coherence'.

The next variable we studied, 'legibility', as a concept, comes from Lynch's book (Lynch, 1960). The Kaplans adapted it for landscape preference theory. In the Kaplan's work (1989) a 'legible space' is defined as 'easy to understand and to remember' and defines the level of expressiveness of scenery elements. Previous studies on landscape legibility generally refer to 'legibility' as defined by the Kaplan model (Herzog and Bryce, 2007; Herzog and Kropscott, 2004; Bogucka, 2021). Therefore, in the survey question concerning both types of landscapes that we studied, the definition basically boiled down to the ease with which one finds the way back (Stamps, 2004; Herzog and Leverich, 2003) and distinctive elements in the landscape (Shayestefar et al., 2022).

The second of the three-dimensional variables, 'mystery', refers to features of the environment that 'promise more to be seen if one could walk deeper into the environment' (Herzog and Smith, 1988). It is also seen as 'interfered exploration' (Stamps, 2004). According to Stamps (2007) 'mystery' belongs to a group of environmental features that constitute the most frequently researched topics in environmental psychology (e.g., Herzog and Kropscott, 2004; Gimblett et al., 1985; Herzog and Miller, 1998). It is a variable that impacts preference for park and forest landscapes (Stamps, 2004; Herzog and Kropscott, 2004). As previous research has shown, 'mystery' is a fortification feature that visitors enjoy (Pardela et al., 2022b). Both mystery and legibility require people in the scene to use their imagination (Suthasupa, 2012). However, the impact of both these variables on fortress landscapes was not studied simultaneously, which in our opinion is worth examining. In the case of the discussed three-dimensional variables, the problem of their mutual relations with different landscapes seems to be more complex.

2.2 Mechanisms behind the relationship between mystery-legibility and preference

Scherer defined the 'preference' concept in 2005. This concept is related to measuring how much people 'like' the appearance of a landscape. The same concept was applied in this study, with preference being defined as "the degree to which respondents appreciate the environment under examination". Therefore, we tend to prefer landscapes that make us feel good and avoid those that make us feel bad (Herzog and Bryce, 2007).

According to the Kaplan model, both legibility and mystery, have a positive effect on preferences. However, research shows that this is not always the case – especially when it comes to mystery. Some studies have shown no such effect occurs or that mystery even has a negative impact on preference (e.g. Herzog and Kirk, 2005; Herzog and Kutzli, 2002; Asadpour, 2017). Research on mystery in forest settings conducted by Herzog and colleagues also supports this (Herzog and Bryce, 2007; Herzog and Kropscott, 2004). Furthermore, Stamps (2004) also proves that there are situations when data show a negative correlation between mystery and preference, demonstrating that the impact of mystery on preferences is not always clear-cut.

Some studies show that legibility (Pardela et al., 2022a) and mystery (Pardela et al., 2022b) influence preferences in a complex way. We have reason to believe that certain features of landscapes may have the opposite effect on legibility and mystery. Mysterious landscapes are usually hard to read. This may be due, inter alia, to the fact that 'settings high in mystery are those with the foreground almost completely blocked' (e.g. by foliage and shadow with just a hint of brighter areas in the distance) (Herzog and

Kropscott, 2004). On the other hand, legible landscapes lose their mystery (Gimblett et al., 1985). For example, making fortified landscapes, devoid of medium and tall vegetation, legible and too 'easy to read' in form and layout is not conducive to mystery and may lead the visitor to disengage or divert attention towards specific distinctive places (e.g., inside buildings or underground rooms – 'wayfinding' or exploration that, in some cases, may be dangerous). If we assume that mystery and legibility are negatively correlated with each other and that both of these variables positively affect preferences, it may suggest that the relationship between three-dimensional factors (legibility and mystery) and preference may be more complex and the answer to how these components affect preferences should take into account the simultaneous impact of both of them. Therefore, in the case of these components, it is worth additionally investigating the mechanisms behind the relationships, not only the correlations between the components and preferences (Figure 1). The ambiguously mentioned results of research on the impact of mystery and legibility on preferences may result, inter alia, from the fact that these variables are negatively correlated with each other (when mystery increases, legibility decreases and vice versa) – indeed, for preference to increase, mystery and legibility cannot both increase at the same time; one of them must fall. So it might be stated that we would like legible landscapes much more if they did not lack mystery, and we would like mysterious landscapes more were it not for the fact that they are usually not very legible.

Distilling these assumptions down to the relationship described by the model of mediating effects, the following hypothesis may be formulated:

H1. Mystery and legibility interact as mutual suppressors

2.3 Danger as a variable explaining the influence of mystery and legibility on preferences

Complex or mysterious natural environments, according to research, increase feelings of danger (Herzog and Bryce, 2007; Herzog and Kropscott, 2004) and landscapes rated low in terms of safety are not liked (Herzog and Kutzli, 2002; Herzog and

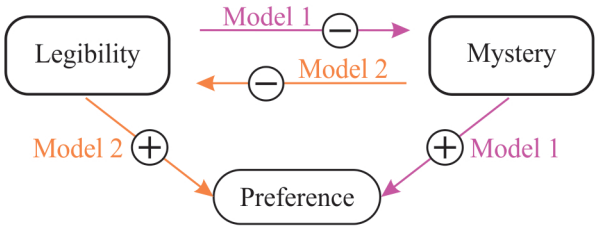

Figure 1. Models where mystery explains the influence of legibility on preferences and legibility explains the influence of mystery on preferences towards landscapes studied.

Flynn-Smith, 2001). However, it should be noted that there are features of a landscape that can evoke conflicting feelings – on the one hand, they can be liked, while on the other, they might cause fear. Such features include sense of privacy (Lis et al., 2019c) or mystery (Herzog and Bryce, 2007; Herzog and Smith, 1988; Gimblett et al., 1985). Research conducted on fortress and park landscapes confirmed that danger can act as a suppressor in the relationship between mystery and preference (Pardela et al., 2022b). We can assume that danger acts in the opposite way to mystery in the relationship between legibility and preference. Legibility enhances orientation and, consequently, facilitates escape, reducing perceived danger, thus making legible landscapes preferable. So, in effect, it can be assumed that danger explains the influence of both these variables on preferences, but it explains it in different ways: mystery is liked even though mysterious landscapes tend to be dangerous, and legibility is liked because legible landscapes are safer than illegible ones (Figure 2).

Taking the above into account, we formulated this hypothesis:

H2. Danger is a variable explaining the influence of mystery and legibility on preference

Figure 2. Models representing the relationships between mystery/legibility and Preference, where danger is a mediator.

To sum up, we sought to determine the differences in preferences for two different types of cultural landscapes – fortress and park landscapes – related to social expectations. Often, green areas in cities are

shaped and maintained in a similar way, regardless of provenance. In our study, we focused on identifying the nature of the relationships between the seven variables. These included coherence, complexity, legibility, mystery, as well as danger, preference and vegetation. We were particularly interested in the role played by danger as a variable explaining the influence of mystery and legibility on preferences, as well as the mechanisms behind the relationship between mystery-legibility and preference.

2.4 Study area

The photos of urban parks were taken in Wrocław, while the photos of fortifications were taken in six former fortress towns in Poland, Central-Europe (Figure 3). The photos present landscapes featuring fortifications built during the German Empire after the second half of the 19th century to the early years of the 20th century. Currently, these fortifications are within the borders of Poland.

2.5 Questionnaire[i-1] *design*

We used a within-subjects design in our study, with participants evaluating a set of 116 eye-level photographs (58 fortified landscapes and 58 urban parks environments). The photographs for the study were chosen from a larger collection of 1500 photographs (500 fortress landscapes and 1000 park landscapes). Photographs depicting fortress landscapes have architectural features typical of the period when the structures were constructed (armament elements, architectural detail, elevation layout, etc.), while the fortifications themselves are scarce and scattered throughout the country. In contrast, the photos taken in urban parks feature few visible architectural elements and lack any particularly decorative plants. Park landscapes are usually much more anonymous and much more common than fortifications. This tends to make one park landscape difficult to distinguish amongst other similar parks in Poland. Considering the above, the urban park pictures were taken in Wroclaw, the authors' home city. Because on that, knowledge of many of the local parks facilitated the selection of sites with diverse landscape features essential for the study.

In this research, we used a method using photos as the unit of analysis (cf. Lis et al., 2019a; Lis and Iwankowski, 2021b; Lis and Iwankowski, 2021a; Herzog and Kirk, 2005; Rijswijk v. and Haans, 2018), chosen at random from a bigger pool to provide a sample that is typical of the landscapes in that category (in our case, fortress and park). This avoids the risk of overestimating or underestimating the effects of the studied variables, which may occur when the photos to be evaluated are selected for specific characteristics (i.e., the variables examined in the study) (Rijswijk v. and Haans, 2018). In order to minimise the possible impact of uncontrolled factors on dependent variables (coherence, complexity, danger, legibility, mystery and preference) which we established, the photos used in the research sample also met specific

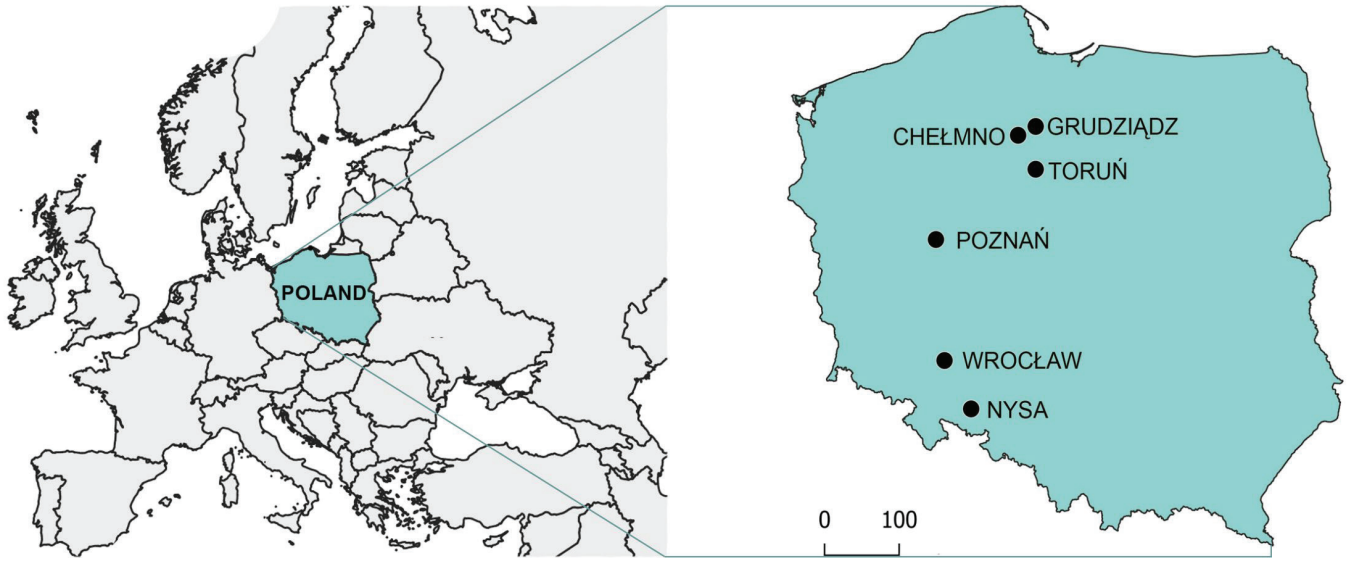

Figure 3. Maps showing the location of the study sites where the photos of fortified and park landscapes were taken.

initial criteria. As a result, the horizon line was consistently in the center of the frame for each eye-level photograph that was taken in landscape mode. All of the photos were taken between 10 am and 3 pm on sunny days during the whole growing season (late spring and summer). The photos omitted any scenes depicting evidence of vandalism or antisocial behaviour. Furthermore, we avoided scenes with obvious decorative components such as plants (with attractive flowers or colourful leaves), architectural or artistic features (such as fountains or statues), water features (such as small lakes or urban watercourses), and others, because they could have an impact on preference.

2.6 Research variables and data collection procedure

The 'vegetation' variable was measured from the photos. This gave us the relative cover of the layer, determined by the total proportion of the photo covered by greenery. All calculations were made in Image J2 (v. 2.4.1/1.53q; Java 1.8.0_322) (Rueden et al., 2017) (Figure 4). This mainly involved selecting and subtracting elements from the total number of pixels in the frame (see also Pardela et al., 2022b; Kuper, 2017).

The other variables—coherence, complexity, danger, legibility, mystery, and preference—were measured based on how the study participants perceived them (Table S3). The average scores obtained by the evaluated scenes formed the core of the analysed data. These variables were evaluated on a single-item 5-point Likert scale (where 5 = the highest, 1 = the lowest). The following questions were developed using operational definitions from environmental psychology (Herzog and Bryce, 2007; Herzog and Kropscott, 2004) and read as follows – for two-dimensional factors (coherence: 'How well does the scene hangs together. How easy is it to organise and structure the scene?' and complexity: 'How much is

Figure 4. An example of the vegetation measurement technique depending on the landscape types.

going on in the scene? How much is there to look at? If the scene contains a lot of elements of different kinds, rate it high in complexity'); for three-dimensional factors; legibility: 'How easy would it be to find your way in the setting? How easy it would be to figure out where you are at any given moment or to find your way back to any given point in the setting'; mystery: 'How much does the setting promise that more could be seen if you just walked further inside? Does the setting seem to invite you to go further inside and discover more?'). For other factors, such as danger or preference, these questions were as follows: 'How much do you like the setting?', 'How dangerous is this setting?', 'How likely is it that you could be harmed in this setting?' accompanied by this clarification: 'This is your own personal degree of liking for the setting as a setting, not as a photo. You don't have to worry about whether you're right or wrong or whether you agree with anybody else.'

2.7 Sampling method

The study involved 117 participants (57 females and 60 males, age range = 18–65 years; Mage = 29.26; SDage = 13.08), whom we recruited by sending requests. The participants completed the surveys voluntarily and without compensation agreed to take part in our study, and were randomly divided into five groups. Each group evaluated the photos for one dimension only (by answering a question on one of the six). As a result, the participants rated landscape photographs for preference (n = 33), danger (n = 28), mystery (n = 22), legibility (n = 35), coherence (n = 29), and complexity (n = 25). Such a procedure is frequently used in studies that analyse landscape assessments (e.g. Lis et al., 2019c; Hoyle et al., 2017; Rijswijk v. and Haans, 2018).

The study was run in a computer laboratory equipped with a NEC M402W projector (with an NP30LP lamp) (1280 × 800) with a 16:10 aspect ratio to display the slides. The 116 photos (grouped as four per slide (Harris et al., 2018; Lis and Iwankowski, 2021a; Lis and Iwankowski, 2021b) presented on 30 slides were rated using a single variable. Each slide was given 30 seconds to be evaluated. The study lasted approximately 25 minutes, including the introduction and distribution of surveys. The research ran from April to May 2022. When selecting participants, we used databases of students and researchers from the university's internal network, from which we randomly selected 160 people, of whom 117 voluntarily decided to participate in the study. We sent invitations by e-mail or by direct contact. Participation was voluntary, completely anonymous and each of the adult participants (over 18 years old) could withdraw at any time during its course. The respondents represented various professional groups (landscape architects, urban planners, architects, dendrologists, biologists) from different backgrounds. They could not be disabled (physically or intellectually), suffering from mental trauma (e.g. PTSD) or mental health disorders, including people who had suffered traumatic experiences in parks. Furthermore, the participants were aware of the question content before starting the survey.

2.8 Data analysis

In our research, the unit of analysis was landscapes. The features of these landscapes, quantified as a result of setting scores and measurements, constituted raw scores. We measured the independent variable (vegetation) directly from the assessed photos. The setting score for the dependent variables (coherence, complexity, mystery, legibility, danger, preference) was determined as an average of the respondents' ratings for a given landscape. Internal consistency reliability coefficients (Cronbach's alpha), ranged from 0.930 to 0.963 (αpreference = 0.930, αcomplexity= 0.963, αcoherence= 0.957, αmystery= 0.942, αlegibility= 0.952, αdanger= 0.959).

We conducted statistical analyses with the JAMOVI 2.2.5 package (The Jamovi Project, 2022). We performed correlation analyses (with Pearson's r coefficient). We used the GML Mediation Model module to analyse mediation. For the p-value calculations for the performed statistical tests, we used the Holm-Bonferroni Method (Holm's Sequential Bonferroni Procedure) (Holm, 1979). We assumed α = .05 as the significance level. We inferred the statistical significance of mediating effects based on Sobel test as well as the 95% confidence intervals determined on the basis of the bootstrap method with randomisation of n = 5000 samples.

3 Results

3.1 Descriptive statistics, comparative analyses of variables for forts and parks

Before proceeding with the actual analyses, we verified the distributions of the measured variables (descriptive statistics and Kolmogorov-Smirnov tests – for the groups of photos showing fortress landscapes and park landscapes separately) (Table S1). The distributions of variables appeared not to differ in a statistically significant way from the normal distribution, since the skewness did not exceed the absolute value of 2 for the 'mystery' variable and greenery in the 'parks' category and equalled 1 for the other variables (George and Mallery, 2016). Next, we checked whether there were any differences between parks and forts in terms of how these spaces were evaluated on the scale of coherence, complexity, mystery, legibility, danger, preference, vegetation (amount/density of greenery). For this purpose, we performed a Student's t-test for independent samples, which gave a statistically significant result in the case of the independent variable (vegetation) and most of the dependent variables. In general, parks turned out to be more attractive – they were more highly rated on the scale of preferences than forts. They were also rated higher on the coherence scale. It also turned out that parks evoke less danger than forts. The forts, on the other hand, were rated as more mysterious. Readability and complexity were not significantly different in the two categories. The results obtained are presented in Table S2.

3.2 Correlations

Pearson's r correlation analysis, performed separately for forts and parks (Table 1), showed that the amount of greenery has a greater impact on the feelings of fort visitors than park visitors. In the case of parks, there is no significant correlation between the quantity of vegetation and preferences, while in the assessment of forts the amount of greenery is relevant – the more there is, the stronger the preference (r = 0.356). Moreover, in the case of forts, the amount of greenery affects all variables except cohesion, causing an increase in variety (r = 0.421), mystery (r = 0.635) and danger (r = 0.510) and a fall in legibility (r = -0.650). In parks, the amount of greenery has a significant impact on negatively correlated legibility only (r = -0.408) and positively correlated sense of danger (r = 0.494).

Among the four components of the Kaplan matrix, complexity (r = 0.646, 0.696) and coherence (r = 0.506, 0.834) are most strongly correlated with preference for both types of landscapes. In addition, in the case of forts there is a strong correlation between mystery and preference (r = 0.630), which in turn does not correlate with preference for park landscapes. The analysis revealed no relationship between legibility and preference in any type of landscape.

3.3 Models of mediating effects

We began testing the mediating effects with two models involving the mystery, legibility and preference variables (Figure 1) – we checked effect of mystery in the relationship between legibility and preference (model 1) as well as the mediating effect of legibility in the relationship between mystery and preference (model 2). In the first part of the analysis, we tested models 1 and 2 for park landscapes. The analysis of the individual paths of model 1 indicated that the statistically insignificant relationship between legibility and preferences becomes statistically significant when controlled for mystery. This means that mystery acts as a suppressor in this relationship (Table 2). Analysis of model 2 for park landscapes showed a cooperative suppression effect. The mystery of park landscapes correlates statistically significantly with preferences, but it is a weak positive correlation, on the verge of statistical significance (p = 0.047). After taking into account and controlling for legibility, the observed positive relationship becomes significantly stronger (Table 3).

We performed two similar analyses (model 1 and model 2) for fortress landscapes. The first analysis (model 1) looked at the mediating role of mystery in the relationship between legibility and preference. It showed that legibility does not directly correlate significantly with preference and the relationship remains statistically insignificant when we control for mystery (Table 4). The second analysis (model 2) revealed no mediating effect. The mystery of fortress

Table 1. Results of a correlation analysis between all measured quantitative variables separately for fort (below diagonal) and park (above diagonal) landscapes. Pearson's R = correlation coefficient, Sig. = significance (p-value after Holm-Bonferroni correction).

		Preference	Complexity	Coherence	Mystery	Legibility	Danger	Vegetation
PARKS								
Preference	Pearson's r	—						
	p-value	—						
Complexity	Pearson's r	**0.646**	—					
	p-value	**< .001**	—					
Coherence	Pearson's r	**0.771**	**0.506**	—				
	p-value	**< .001**	**0.001**	—				
Mystery	Pearson's r	0.255	0.374	0.037	—			
	p-value	0.537	0.050	1.560	—			
Legibility	Pearson's r	0.131	-0.234	0.268	**-0.571**	—		
	p-value	0.986	0.614	0.462	**< .001**	—		
Danger	Pearson's r	-0.215	0.182	-0.345	**0.619**	**-0.852**	—	
	p-value	0.635	0.863	0.096	**< .001**	**< .001**	—	
Vegetation	Pearson's r	0.176	0.225	-0.031	0.243	**-0.408**	**0.494**	—
	p-value	0.863	0.621	1.560	0.595	**0.021**	**0.001**	—
FORTS								
Preference	Pearson's r	—						
	p-value	—						
Complexity	Pearson's r	**0.696**	—					
	p-value	**< .001**	—					
Coherence	Pearson's r	**0.834**	**0.581**	—				
	p-value	**< .001**	**< .001**	—				
Mystery	Pearson's r	**0.630**	**0.640**	**0.521**	—			
	p-value	**< .001**	**< .001**	**< .001**	—			
Legibility	Pearson's r	-0.194	**-0.373**	0.066	**-0.415**	—		
	p-value	0.726	**0.003**	0.964	**0.011**	—		
Danger	Pearson's r	-0.156	0.109	-0.285	**0.495**	**-0.505**	—	
	p-value	0.964	0.964	0.180	**< .001**	**0.001**	—	
Vegetation	Pearson's r	**0.356**	**0.421**	0.146	**0.635**	**-0.650**	**0.510**	—
	p-value	**0.043**	**0.010**	0.964	**< .001**	**< .001**	**0.001**	—

Table 2. Results of the analysis of the mediating effect of mystery in the relationship between legibility and preference (model 1) for park photos. SE = standard error, β = standardised regression coefficient, z = z-score, p = significance level. The bold confidence interval was determined on the basis of the bootstrap method with a drawing of n = 5000 samples.

				95% C.I. (a)				
Type	Effect	Estimate	*SE*	Lower	Upper	*β*	*z*	*p*
Indirect	Legibility > Mystery > Preference	-0.1175	0.0441	**-0.2110**	**-0.0389**	-0.278	-2.664	0.008
Component	Legibility > Mystery	-0.3014	0.0635	-0.4344	-0.1828	-0.571	-4.749	< .001
	Mystery > Preference	0.3899	0.1061	0.1646	0.5857	0.488	3.674	< .001
Direct	Legibility > Preference	0.1726	0.0677	0.0512	0.3203	0.409	2.548	0.011
Total	Legibility > Preference	0.0551	0.0554	-0.0535	0.1637	0.131	0.994	0.320

Table 3. Results of the analysis of the mediating effect of legibility in the relationship between mystery and preference (model 2) for park photos. All abbreviations and acronyms as in case of the Table 1.

				95% C.I. (a)				
Type	Effect	Estimate	*SE*	Lower	Upper	*β*	*z*	*p*
Indirect	Mystery → Legibility → Preference	-0.186	0.0802	**-0.37518**	**-0.0555**	-0.233	-2.32	0.020
Component	Mystery → Legibility	-1.080	0.1795	-1.47739	-0.7662	-0.571	-6.02	< .001
	Legibility → Preference	0.173	0.0682	0.05194	0.3160	0.409	2.53	0.011
Direct	Mystery → Preference	0.390	0.1071	0.16553	0.5935	0.488	3.64	< .001
Total	Mystery > Preference	0.203	0.1023	0.00292	0.4040	0.255	1.99	0.047

Table 4. Results of the analysis of the mediating effect of mystery in the relationship between legibility and preference (model 2) for the fort photos. All abbreviations and acronyms as in case of the Table 1.

				95% C.I. (a)				
Type	Effect	Estimate	*SE*	Lower	Upper	*β*	*z*	*p*
Indirect	Legibility → Mystery → Preference	-0.1282	0.0374	**-0.2074**	**-0.0601**	-0.2752	-3.425	< .001
Component	Legibility → Mystery	-0.1919	0.0499	-0.2908	-0.0952	-0.4147	-3.848	< .001
	Mystery → Preference	0.6683	0.1059	0.4610	0.8746	0.6636	6.311	< .001
Direct	Legibility → Preference	0.0380	0.0512	-0.0660	0.1367	0.0815	0.742	0.458
Total	Legibility > Preference	-0.0902	0.0606	-0.2089	0.0285	-0.1936	-1.490	0.136

Table 5. Results of the analysis of the mediating effect of legibility in the relationship between mystery and preference (model 2) for the fort photos. All abbreviations and acronyms as in case of the Table 1.

				95% C.I. (a)				
Type	Effect	Estimate	*SE*	Lower	Upper	*β*	*z*	*p*
Indirect	Mystery → Legibility → Preference	-0.0341	0.0485	**-0.1335**	**0.0631**	-0.0338	-0.702	0.483
Component	Mystery → Legibility	-0.8962	0.2193	-1.3619	-0.4830	-0.4147	-4.087	< .001
	Legibility → Preference	0.0380	0.0508	-0.0623	0.1343	0.0815	0.748	0.455
Direct	Mystery → Preference	0.6683	0.1036	0.4673	0.8759	0.6636	6.453	< .001
Total	Mystery → Preference	0.6342	0.1036	0.4311	0.8373	0.6298	6.121	< .001

landscapes sits positively with preference and this correlation does not change statistically significantly when controlling for legibility in the model (Table 5).

The second group of tested models (models 3 and 4) examined the mediating role of danger in the relationship between mystery/legibility and preference. First of all, we tested these models for park landscapes. The test results of model 3 reveal cooperative suppression. The weak positive correlation between mystery and preference becomes stronger when we control for danger in the model (Table 6). This means that danger acts as a suppressor in this relationship. The second analysis (model 4) concerned the mediating role of danger in the relationship between legibility and preference. It showed that legibility does not significantly correlate with

Table 6. Results of the analysis of the mediating effect of Danger in the relationship between Mystery and Preference (model 3) for park photos. All abbreviations and acronyms as in case of the Table 1.

				95% C.I. (a)				
Type	Effect	Estimate	*SE*	Lower	Upper	*β*	*z*	*p*
Indirect	Mystery → Danger → Preference	-0.298	0.0833	**-0.48076**	**-0.155**	-0.373	-3.58	< .001
Component	Mystery → Danger	0.862	0.1248	0.66478	1.156	0.619	6.91	< .001
	Danger → Preference	-0.346	0.0800	-0.50412	-0.187	-0.603	-4.32	< .001
Direct	Mystery → Preference	0.501	0.1046	0.28313	0.704	0.628	4.80	< .001
Total	Mystery → Preference	0.203	0.1023	0.00292	0.404	0.255	1.99	0.047

Table 7. Results of the analysis of the mediating effect of danger in the relationship between legibility and preference (model 4) for park photos. All abbreviations and acronyms as in case of the Table 1.

				95% C.I. (a)				
Type	Effect	Estimate	*SE*	Lower	Upper	*β*	*z*	*p*
Indirect	Legibility → Danger → Preference	0.1355	0.1025	**-0.0351**	**0.3706**	0.321	1.323	0.186
Component	Legibility → Danger	-0.6270	0.0566	-0.7377	-0.5159	-0.852	-11.075	< .001
	Danger → Preference	-0.2162	0.1559	-0.5633	0.0547	-0.377	-1.387	0.166
Direct	Legibility → Preference	-0.0805	0.1129	-0.3347	0.1242	-0.191	-0.713	0.476
Total	Legibility → Preference	0.0551	0.0554	-0.0535	0.1637	0.131	0.994	0.320

Table 8. Results of the analysis of the mediating effect of danger in the relationship between mystery and preference (model 3) for the fort photos. All abbreviations and acronyms as in case of the Table 1.

				95% C.I. (a)				
Type	Effect	Estimate	*SE*	Lower	Upper	*β*	*z*	*p*
Indirect	Mystery → Danger → Preference	-0.309	0.0875	**-0.500**	**-0.157**	-0.307	-3.53	< .001
Component	Mystery → Danger	0.685	0.1655	0.370	1.021	0.495	4.14	< .001
	Danger → Preference	-0.451	0.0601	-0.563	-0.330	-0.620	-7.51	< .001
Direct	Mystery → Preference	0.943	0.0786	0.797	1.106	0.937	12.00	< .001
Total	Mystery → Preference	0.634	0.1036	0.431	0.837	0.630	6.12	< .001

preference directly and the relationship remains statistically insignificant when we control for danger (Table 7). The same models tested for fortress landscapes yielded partially different results. The test results for model 3 reveal, as in the case of parks, cooperative suppression. The fairly strong positive correlation between mystery and preference becomes even stronger when we control for danger in the model (Table 8). This means that in the case of parks too, danger acts as a suppressor in this relationship. On the other hand, testing model 4 for fortress landscapes gave a different result than in the case of park landscapes (Table 9). Here it is a question of suppression without controlling for danger in the model; the relationship between legibility and preference is statistically insignificant.

Table 9. Results of the analysis of the mediating effect of danger in the relationship between legibility and preference (model 4) for the fort photos. All abbreviations and acronyms as in case of the Table 1.

				95% C.I. (a)				
Type	Effect	Estimate	*SE*	Lower	Upper	*β*	*z*	*p*
Indirect	Legibility → Danger → Preference	0.0803	0.0384	**0.0119**	**0.1622**	0.172	2.09	0.036
Component	Legibility → Danger	-0.3235	0.0565	-0.4386	-0.2182	-0.505	-5.72	< .001
	Danger → Preference	-0.2484	0.1104	-0.4696	-0.0411	-0.341	-2.25	0.024
Direct	Legibility → Preference	-0.1706	0.0604	-0.2950	-0.0573	-0.366	-2.82	0.005
Total	Legibility → Preference	0.0902	0.0606	-0.2089	0.0285	-0.194	-1.49	0.136

4 Discussion

The impact of legibility and mystery on visitor preferences, as well as the mechanisms underlying these variables, were investigated in his study in two different types of cultural landscape: fortified and parks. All predictors of the Kaplan preference matrix, along with danger and vegetation, were accounted for. The results confirm previous research and show that the two-dimensional factor effect is strong and acts regardless of the type of landscape. In the park and fortress landscapes we studied, coherence and complexity were most strongly correlated with preference. The respondents perceived parks as more attractive and cohesive than fortifications, which in turn were more mysterious and dangerous, which is consistent with previous results (Pardela et al., 2022a). The role of vegetation was also confirmed, which reduces legibility and increases sense of danger in parks (Lis et al., 2022). On the other hand, in fortress landscapes, greenery contributes to an increase in diversity and mystery that is popular with visitors (Pardela et al., 2022b), although it does reduce the legibility of forts and increase perceived danger. In the case of the three-dimensional factors we studied (i.e., legibility and mystery), they turned out to operate in complex ways whose mechanisms were revealed by the analyses of mediating effects (models 1-4).

In the case of mystery, there are clear differences between forts and parks – for fortress landscapes, the positive relationship between mystery and preference is clearly greater than for park landscapes, which is consistent with previous research (Pardela et al., 2022a; Pardela et al., 2022b) . Moreover, analysis of mediating effects revealed that the positive association of mystery with preference for parks would be even greater were it not for the negative impact of low legibility and sense of danger that go hand in hand with mysterious landscapes. Such a relationship is not particularly relevant for forts, where the influence of mystery on preferences is strong, regardless of its relationship with danger and legibility. This may be due to the fact that fortifications are surrounded by an aura of mystery conducive to their perception as niche tourist attractions (military cultural tourism or even dark tourism – visiting famous battlefields, etc.).

In relation to legibility, it appeared to have no correlation with preference, which is inconsistent with the assumptions of the Kaplan matrix and later research (e.g., Herzog and Leverich, 2003; Herzog and Kropscott, 2004). However, our analyses showed that in the case of parks, the lack of this correlation is only superficially apparent at first glance. In fact, legibility has a positive effect on preferences, but this influence is hindered by the fact that legible landscapes are at the same time not very mysterious. However, if mystery is controlled for, then the influence of legibility on preferences emerges as a positive influence. Such a result indicates how strongly mystery impacts perception of park landscapes. Without it, even legible landscapes cease to be liked.

The situation looks different in the case of fortified landscapes. Here, contrary to our predictions, legible landscapes are not popular regardless of the fact that they are less mysterious. Mystery does not ex-

plain the lack of influence of legibility on preferences. Moreover, when we control for danger, legibility turns out to be a negative predictor of preference, which is really rather surprising. It shows that were it not for the fact that legibility reduces sense of danger, legible forts would be disliked. This may be due to the specific, genetic features of a fortress landscape (e.g. connected with the shape of the terrain, as in the case of parks (Lis et al., 2022)), or it may reveal the respondents' tendency to independently explore historic buildings in an environment that is preferably safe. Mystery can then be equated with enigmatic 'hidden' buildings overgrown with vegetation along with their armaments, all of which stimulates the imagination. Wielgus and colleagues (Wielgus and Wielgus, 2018), writing about the perception of fortified landscapes in Poland (Kraków), indicate that among the three associations with fortifications mentioned by the respondents, the most frequent word was 'defence' – i.e., a function historically associated with safety. However, this aspect of our results requires further research.

4.1 Limitations

While conducting our research, we had certain limitations in mind.

The first limitation is the research method we used. Landscapes were the unit of analysis, while most studies use individual people. Our method is used when the research is focused on landscapes features rather than people (Pardela et al., 2022a; Lis and Iwankowski, 2021a; Lis and Iwankowski, 2021b; Rijswijk v. and Haans, 2018). The adopted approach takes into account the variability of landscape features, which, thanks to the random selection of photos from a large database of 1500 photos, constitute a good representation of real fortress and park landscapes. However, this method is not devoid of limitations. It cannot determine how the characteristics of the surveyed people (e.g. age, sex, education, etc.) influence their assessment of landscapes, because the photos are evaluated in terms of each of the variables by a different group of respondents.

Secondly, the fortifications selected for the study constitute a group selected in terms of their provenance and period of construction, which is, however, but a fragment of the rich and diverse stock of historic fortifications located in Poland. The fortifications in our study are characterised by a similar historical structural and functional solutions, but they differentiate in terms of their original purpose, current state of preservation and technical state, status of legal protection, method of contemporary development or tourist access. The search for and selection of various sites within a small resource pool inevitably meant that different shots had to be used from the same site.

Thirdly, the survey used photos of landscapes instead of on-site surveys in order to be able to involve more participants and due to the cost-effectiveness of this solution. On the other hand, field research would have been able to take into account a number of important factors omitted in the photographs. These may be factors related to the observation of the landscape in motion and from different angles. Such a view has an impact on the variables studied, and especially on the respondents' evaluation of the readability of historic fortification structures.

Finally, further research may aim to discover more about preferences: (1) as a consequence of the need to use alternative scenarios presenting different ways of maintaining greenery (using VR and AR techniques), (2) by questioning groups of professional and 'regular' visitors with a special focus on individuals who are less nature oriented. Studies may also be conducted on large and random samples with a cross-cultural study design within the scope of resolving transdisciplinary problems connected with landscape shaping (Nassauer, 2023).

4.2 Practical implications

The results of our research and their interpretation offer some practical implications on how to shape park and fortress landscapes, primarily with regard to mystery and legibility.

In case of mystery: According to the respondents, mystery is a desired feature in both types of landscapes studied, the difference being that in the case of parks, effort should be made to limit the negative impact of low legibility and sense of danger – for example, through social control or landscape interiors with legible layouts, appropriately arranged and emphasised by a dominant or hierarchical communica-

tion system (historical or contemporary) and open views (cf. Lis et al., 2022).

As the influence of mystery on the respondents' preferences is clearly stronger for fortress landscapes than for parks, this should be reflected in methods of conservation, revalorisation and landscape gardening in historical post-fortress areas. This applies in particular to areas with well-preserved defensive constructions (19th/20th cent.) in the form of park areas or with parks in their immediate vicinity, where an effective distribution of accents will help not only to preserve and display the historical values of a fortified landscape, but also to preserve valuable contemporary values, including spatial, scenic and ecological relations (e.g., increasing biodiversity).

In case of legibility: Overly legible park landscapes devoid of mystery are not liked by the respondents. So, if designers wish to include mystery and legibility in a park, they can use zoning so that visitors in search of mystery can find it, for example, in the vegetation (variety of forms and species, multi-species compositions kept in a natural state and without sculpting), located away from paths and vice versa – those who want legibility can be given visual and physical access as well as distinctive elements to help find their way and navigate.

In the case of fortress landscapes that are genetically scenic and visual, legibility should not be 'literal' or 'boring', as this may result in a lack of engagement from visitors and negative emotional responses to fortified landscapes. Leaving behind some hidden information may be conducive to discovering and exploring the content of fortress landscapes from the turn of the 19th and 20th centuries (the inception, heyday and twilight of the fortifications – a record of material history) without excessive visual consumption and the negative impact of 'dissecting' historical fortifications for cultural tourism (Środulska-Wielgus, 2016). While maintaining mystery, legibility can be conducive to the perception of defensive constructions, especially when viewed close up and the unique details of the fortress landscape are exposed (in meso- and infra-scale), which offers educational value and stimulates visitors' imagination while maintaining optimal tourist, adaptive and scenic restraint.

5 Conclusions

The outcomes of our research clearly indicate that the effect of the two-dimensional factors is strong and independent of landscape type – coherence and complexity were most strongly correlated with preference. In turn, three-dimensional factors turned out to be complex in action, whose mechanisms were revealed by analysing mediating effects. Our research has expanded the existing state of knowledge regards g the hidden mechanisms (especially the impact of danger as a mediator) behind the complex relationships explaining the effect of mystery and legibility on preferences in two different types of landscapes – parks and fortresses. Learning about these mechanisms may influence how park and fort landscapes (including conservation work) are shaped based on selected features related to their perception. In-depth comparative studies between different types of green areas are important when, for example, a fortified landscape is intended to function as a park or parks/forest area within an urban green area system. In the case of heritage fortifications, this is based on a limited, engineered historical space. It is not possible to modify the topography, due to the need to protect earth forms, completely eliminate greenery or create typically decorative plant compositions across large areas. In this case, effort should be made to improve the quality of the space, not only in terms of natural and conservation valorisation (taking into account planning provisions), but also taking account research into social preferences. The priority is to expose the most valuable elements of the fortifications with respect to the historical substance, while preserving the greenery (historical and modern) that supports this goal. Indeed, this is what the visitors like. Modern parks do not have such qualities, despite the fact that in our study they were rated higher on the scale of preferences. In turn, a strong preference for parks may indirectly result from their quantity and popularity, and perhaps also from the fact that historic fortifications are generally few and far between as well as poorly maintained.

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Conflicts of Interest

Th The authors declare no conflict of interest.

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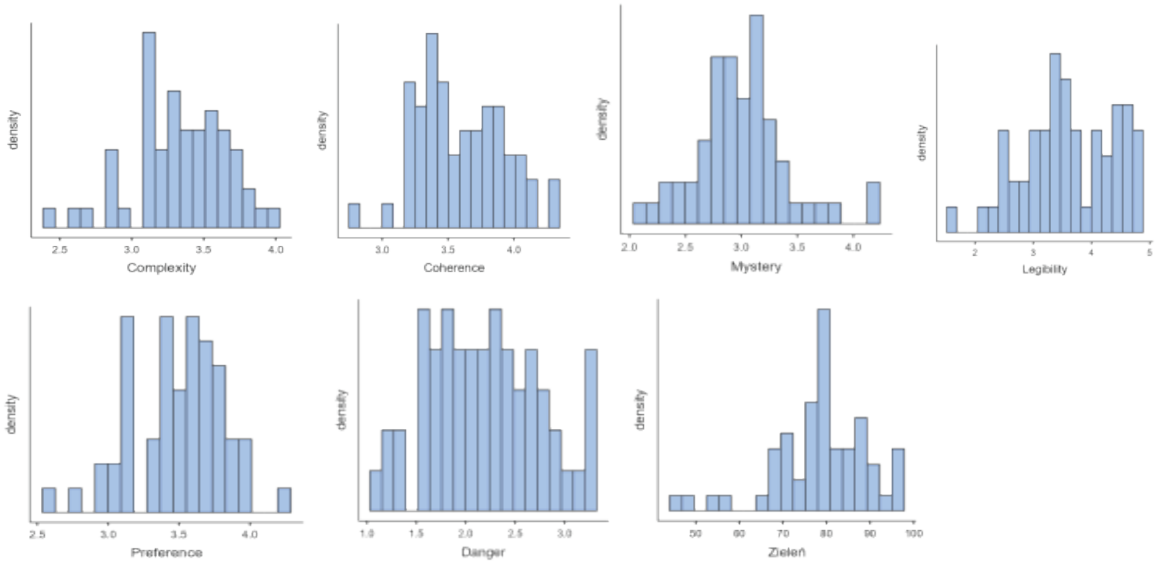
Supplementary Materials

Table S1. Descriptives and Kolmogorov-Smirnov test for park and fortress landscapes.

	Preference	Complexity	Coherence	Mystery	Legibility	Danger	Vegetation
PARKS							
N	58	58	58	58	58	58	58
Mean	3.50	3.33	3.60	3.00	3.61	2.20	78.6
Median	3.55	3.34	3.54	3.00	3.54	2.16	79.1
Standard deviation	0.329	0.322	0.330	0.412	0.779	0.573	10.8
Minimum	2.61	2.40	2.79	2.14	1.63	1.11	46.1
Maximum	4.27	3.96	4.31	4.23	4.83	3.29	97.2
Skewness	-0.391	-0.442	0.119	0.622	-0.237	0.149	-0.878
Std. error skewness	0.314	0.314	0.314	0.314	0.314	0.314	0.314
Kurtosis	0.0777	0.281	-0.463	1.43	-0.642	-0.721	1.40
Std. error kurtosis	0.618	0.618	0.618	0.618	0.618	0.618	0.618
K-S test statistic (D)	0.097	0.075	0.108	0.116	0.099	0.078	0.129
K-S p-value	0.607	0.872	0.472	0.390	0.584	0.849	0.266
FORTS							
N	58	58	58	58	58	58	58
Mean	2.69	3.15	2.87	3.62	3.43	3.36	68.3
Median	2.66	3.08	2.77	3.66	3.71	3.54	69.0
Standard deviation	0.511	0.553	0.546	0.508	1.10	0.703	16.6
Minimum	1.79	2.20	1.83	2.36	1.29	1.79	33.8
Maximum	4.06	4.28	4.59	4.50	4.89	4.39	96.1
Skewness	0.273	0.0288	0.498	-0.545	-0.526	-0.791	-0.200
Std. error skewness	0.314	0.314	0.314	0.314	0.314	0.314	0.314
Kurtosis	-0.331	-0.982	0.394	-0.0477	-0.998	-0.192	-1.02
Std. error kurtosis	0.618	0.618	0.618	0.618	0.618	0.618	0.618
K-S test statistic (D)	0.078	0.078	0.089	0.094	0.166	0.131	0.093
K-S p-value							



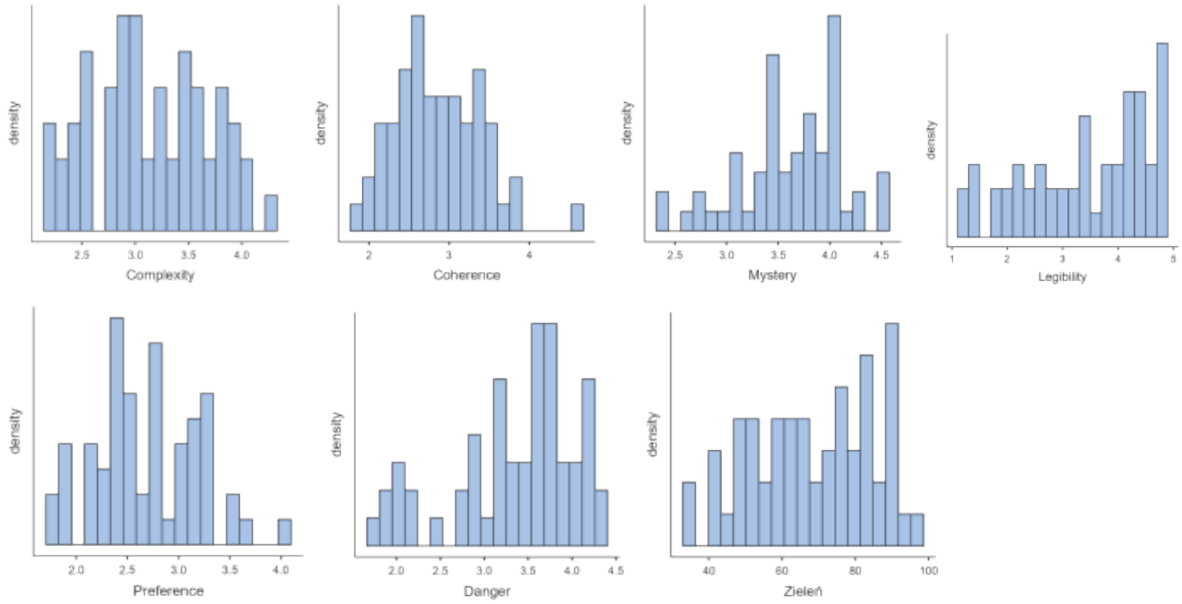


Table S2. Independent Samples T-Test.

		Statistic	df	p*
Preference	Student's t	10.133	114	< .001
Complexity	Student's t	2.215	114	0.057
Coherence	Student's t	8.762	114	< .001
Mystery	Student's t	-7.166	114	< .001
Legibility	Student's t	0.984	114	0.327
Danger	Student's t	-9.722	114	< .001
Vegetation	Student's t	3.943	114	< .001

p*- p-value after Holm-Bonferroni correction

	Group	**N**	**Mean**	**Median**	***SD***	***SE***
Preference	parks	58	3.50	3.55	0.329	0.0432
	forts	58	2.69	2.66	0.511	0.0672
Complexity	parks	58	3.33	3.34	0.322	0.0423
	forts	58	3.15	3.08	0.553	0.0726
Coherence	parks	58	3.60	3.54	0.330	0.0433
	forts	58	2.87	2.77	0.546	0.0717
Mystery	parks	58	3.00	3.00	0.412	0.0540
	forts	58	3.62	3.66	0.508	0.0667
Legibility	parks	58	3.61	3.54	0.779	0.1023
	forts	58	3.43	3.71	1.098	0.1441
Danger	parks	58	2.20	2.16	0.573	0.0753
	forts	58	3.36	3.54	0.703	0.0923
Vegetation	parks	58	78.57	79.10	10.845	1.4240
	forts	58	68.31	69.03	16.571	2.1759

Table S3. Research questionnaire design.

Research questionnaires (Questions 1-6)

Age……

Sex: ☐ F ☐ M ☐ I'd rather not say:

Headers

1. **Preference**: How much do you like the setting? This is your own personal degree of liking for the setting as a setting, not as a photo. You don't have to worry about whether you're right or wrong or whether you agree with anybody else.
   Answer the question on a scale from 1–5, where 1 = I don't like it at all and 5 = I like it a lot

2. **Danger**: 'How dangerous is this setting? How likely is it that you could be harmed in this setting?' This is your own personal degree of liking for the setting as a setting, not as a photo. You don't have to worry about whether you're right or wrong or whether you agree with anybody else.

3. **Coherence**: How well does the scene hang together? How easy is it to organise and structure the scene?

4. **Complexity**: How much is going on in the scene? How much is there to look at? If the scene contains a lot of elements of different kinds, rate it high in complexity.

5. **Legibility**: How easy would it be to find your way in the setting? How easy it would be to figure out where you are at any given moment or to find your way back to any given point in the setting?

6. **Mystery**: 'How much does the setting promise that more could be seen if you just walked a little further? Does the setting seem to invite you to proceed further and discover more?

Below each question there was a scale to mark responses.
Answers were on a scale from 1–5, where 1 = I don't like it at all and 5 = I like it a lot.

Photo no.	1 Not at all	2 Not much	3 Neither like nor dislike	4 Quite a lot	5 A lot
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
…					
117					